The Electrical Industry's Weekly Magazine

February 18, 1957

Electrical World

Price 35 Cents

A McGraw-Hill Publication

Big Units Bring Auxiliary System Problems

.....page 77

Testing the Coal Pipeline to Eastlake..page 63

E B POWER
UNIVERSITY MICROFILMS IN
313 N 1 ST
ANN ARBOR MICH

Compare Cost of Regulators and LTC Transformers

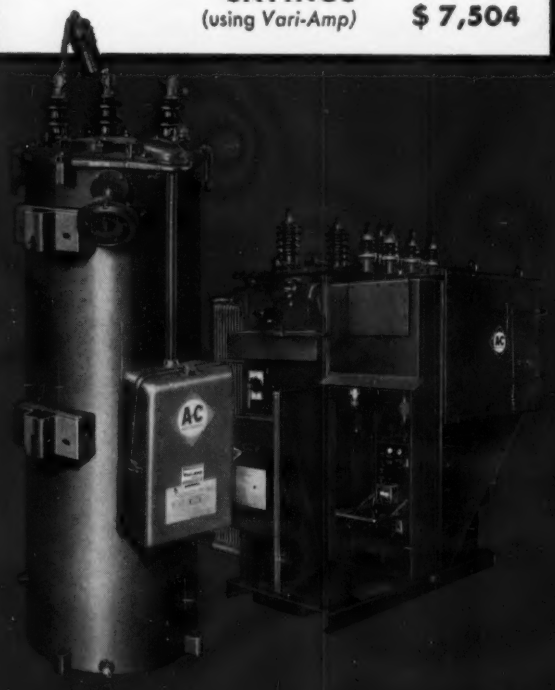
Regulators save $7,504

Here are the four steps needed to make this comparison:

1. **Select substation size.**
2. **Determine percent regulation required.**
3. **Select proper size regulating unit, based either on current or kva, and range of regulation required.**
4. **Compare cost of LTC portion of transformer and 3 distribution regulators.**

In this example, the substation size is 7500 kva, 328 amperes, 13,200 volts, self-cooled. Regulation required is +10% −5%.

LTC on transformer with ±10% regulation - - - -	$19,174
3 Distribution Regulators with +10% −5% regulation - -	11,670
SAVINGS (using *Vari-Amp*)	$ 7,504



Key to savings is *unequal* range of regulation using *Vari-Amp*

Regulation needs are figured either on basis of setting permanent taps of transformer up 5%; or using an alternate voltage on low voltage winding to provide a 5% boost.

Then only a 5% raise from the regulator is needed. On maximum load the transformer raises voltage 5%; regulator raises voltage 5% . . . a net raise of 10%.

This requires regulators to carry 7500 through kva or 328 amperes at the 5% *Vari-Amp* position.

On minimum load the transformer raises voltage 5%; regulator lowers voltage 10%, which gives a net result of −5%. The regulator is allowed to go to −10% because load current has dropped below the 10% current rating of the regulator.

The selection: regulators rated 167 kva, 7620 volts, 219 amperes.

Comparing costs shows a saving of $7504 using Allis-Chalmers distribution regulators with *Vari-Amp*.

Allis-Chalmers Originators of:
- 5/8% step regulators
- Unit construction
- *Vari-Amp*

See what you can save!

Get a bid on A-C regulators next time you figure a substation. Ask your nearby A-C office or write for "Key to low cost regulation," No. A-5307. Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

A-5297

ALLIS-CHALMERS

Electrical World

Vol. 147, No. 7 FEB. 18, 1957

Published for 83 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

Features

CURRENT EVENTS

For Underground Systems: Special Rates?
California PUC authorizes a special schedule for Southern California Edison Co. . . . . p 64

East-West Power Tie Lasts Six Minutes
Grids are paralleled in an experiment aimed at yielding switching and generator data. . . . . p 66

High Interest Has Impact on Utility Money
Unless business expansion flattens out later this year, lower long-term senior security yields seem unlikely. . . . . p 68

INDUSTRIAL

What Is an Industrial Customer Worth?
Load factor, maximum demand, supply voltage affect desirability; rule-of-thumb estimates may dilute revenues. . . . p 74

MANAGEMENT

Revamped Collecting Saves $15,000 Yearly
Revised policies and procedures reduce collection costs and give customers more time to pay. . . . . p 72

Special Report

What's Needed in Auxiliary Supply Systems for Large Units
Different designers solve problem by different approaches, but motor-driven BF remains feasible. . . . . p 77

Departments

Atomic Progress 67
Books 142
Catalogs and Bulletins 128
Editorials 61
Electrical Newsletter 21
From the Publisher 5
How To 95
Management Newsletter 159
Manufacturers and Markets 146
Meetings Calendar 170
Meeting Reports 70
New Equipment 120
News About People 166
News-Beat 70
Readers Forum 172
Sales Assignments 152
Selling 112
Technical Literature 128
Washington Wire 65

INDEX TO ADVERTISERS 177

Mr. C. J. Cox (at right, above) supervises the installation of Okonite Splicing Tape on 2300 volt motor lead in Seabrook Farms food freezing plant. For 29 years Mr. Cox has standardized on Okonite splicing materials to assure water-tight seals on cables throughout the plant. Note moisture conditions indicated by frozen condensation on pump head.

Okonite Tapes resist moisture, freezing...

keep world's largest food freezing plant operating

For 29 years, Mr. C. J. Cox, supervisor of all construction and engineering for Seabrook Farms Co., has depended on Okonite Tapes to maintain the vast electrical network that keeps the world's largest food freezing plant operating. All electrical circuits (totaling 20,000 h.p. connected load), lights, as well as power for the motors and pumps which provide continuous freezing and storage capacity, are spliced and terminated with waterproof Okonite Tapes to assure positive protection against the moisture always present in the plant.

In every phase of Seabrook's operation, moisture is a problem. Treatment of food, freezing, processing, storing . . . all are damp operations with continuous condensation on cables and equipment alike. Low temperatures of the freezing and holding rooms make splicing difficult.

Okonite Tapes offer effective waterproof splices that are not affected by dampness or low temperatures. Both Okonite Rubber Tape and Okolite High Voltage Tape fuse into a solid self-vulcanizing wall of tough, waterproof insulation. Protected by Manson Friction Tape, splices maintain their moisture resistance through many years of exposure to condensation and freezing temperatures.

Specify Okonite tapes for the tougher jobs. Get them from your Okonite Tape Distributor, or write to The Okonite Company, EW Tape Department, Passaic, New Jersey.

Available through authorized distributors only

OKONITE

splicing materials

3521-A

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. . . *from the publisher*

Back in the Twenties a young copywriter filled magazine pages with an advertising campaign that could well be repeated today.

Under such headlines as "The glory of the upward path," he held out the promise of greater success to businessmen anxious to get ahead. Recognized as some of the greatest ads ever written, they sold thousands of courses for the training institute which sponsored them, helped countless business people to help themselves, and brought valuable recognition to their writer.

His name was Bruce Barton, now one of the nation's great business leaders. "Few men," he wrote, "ever gain an all-round knowledge (of their business); so few that the demand for them is always in excess of the supply. They are the men who reach the heights of executive responsibility. . ."

What is it these men of "executive responsibility" know about, think about, and talk about? If it has anything to do with the electric power industry, chances are you'll find it in Electrical World's new weekly Management Newsletter.

This issue's Management Newsletter begins on page 159. If you're a member of the management team, read it weekly to keep abreast of the things of policy-making significance. If you're not, all the more reason to keep on top of the "big picture." We can't guarantee that it will someday put you in the executive ranks. But it will help.

Fischer Black

ELECTRICAL WORLD

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he can switch your 12 kv feeders anywhere, any time, under any load with a hook stick using an S&C LOAD INTERRUPTER

The stick-operated S&C Alduti Load Interrupter in use

Sure! The switching of your 12 kv distribution feeders is getting tougher and tougher! Maybe your linemen are living with it, or maybe you are spending a fortune just to get by.

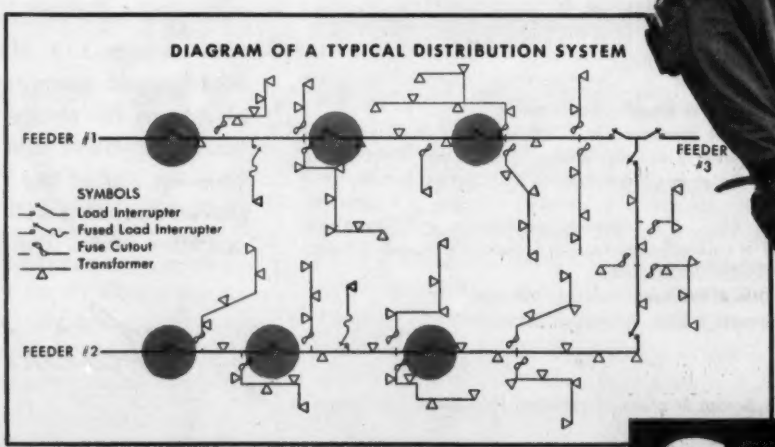
Is there another alternative?

Certainly! A stick-operated S&C Load Interrupter. It can switch positively—under any condition—any load, whether it's line charging current, capacitor charging current, magnetizing current, or full load. And it can be done without the hazards and uncertainties of an external arc. Here's a switch that will keep your linemen happy, and the comptroller, too.

USE IT AT SECTIONALIZING POINTS

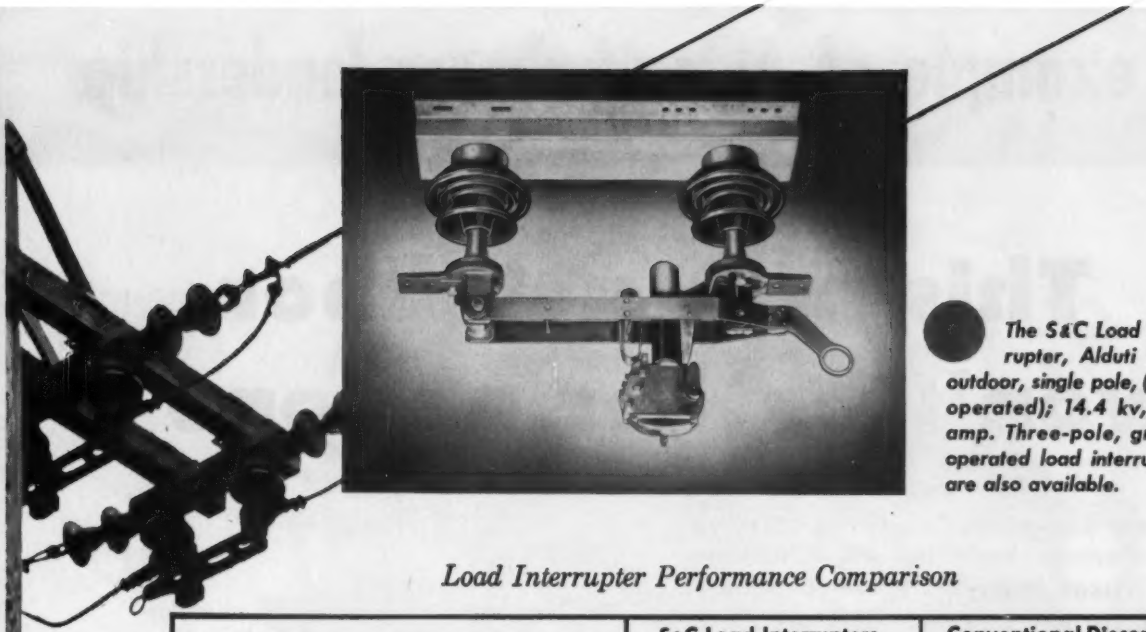
On 12 kv *radial* circuits, increased loads have made switching at sectionalizing points virtually impossible with conventional disconnects. On *loop* circuits (right) it's difficult enough where the duty involves only switching in parallel. And if the tie switches are open, hazard-free circuit interruption can be an impossibility.

Here, S&C Load Interrupters will give you safe, positive, circuit interruption on full line voltage and full load current—an advantage under emergency conditions, and a convenience under normal circumstances.



Specialists in High-Voltage Circuit Interruption since 1910

S&C



The S&C Load Interrupter, Alduti type; outdoor, single pole, (stick-operated); 14.4 kv, 600 amp. Three-pole, group-operated load interrupters are also available.

Load Interrupter Performance Comparison

PERFORMANCE	S&C Load Interrupters		Conventional Disconnects	
	Stick-Operated	Group-Operated	Stick-Operated	Group-Operated
Interrupt current from parallel sources safely?	YES	YES	DOUBTFUL	DOUBTFUL
Safe to equipment or personnel if inadvertently opened on full voltage (in case loop is open)?	YES	YES	NO	DOUBTFUL
Dump load without opening feeder breaker, or without preliminary unloading?	YES	YES	NO	DOUBTFUL
Multi-pole device controllable from ground (may be required by system practice or other circuits on same pole)?	NO	YES	NO	YES
Interrupt line charging current safely?	YES	YES	NO	DOUBTFUL
Cost?	LOW	HIGHEST	LOWEST	HIGH

The S&C Load Interrupter can switch the circuit without unloading preliminaries and without opening the breakers. The use of S&C Load Interrupters cannot lead to dangerous phase-to-phase or phase-to-ground faults, because there is NO EXTERNAL ARC. Also there is no danger to men or equipment in case of inadvertent operation. The S&C Load Interrupter breaks all load and charging currents instantly and decisively. Besides, you can mount it in any desired position —vertical, upright, or inverted. Write today for Catalog Section 760 on S&C Load Interrupters.

LOAD INTERRUPTERS

S&C ELECTRIC COMPANY

An example of Allis-Chalmers leadership

This new neighbor won't bother anyone

New low-sound-level 125,000-kva transformer built by Allis-Chalmers for Wisconsin Electric Power Company bulk station in residential area.

Even residents of homes only 300 feet away will have no reason to complain about this good neighbor. It was specially designed to create good will.

Because of the location, Wisconsin Electric Power Company required a transformer with a low noise level.

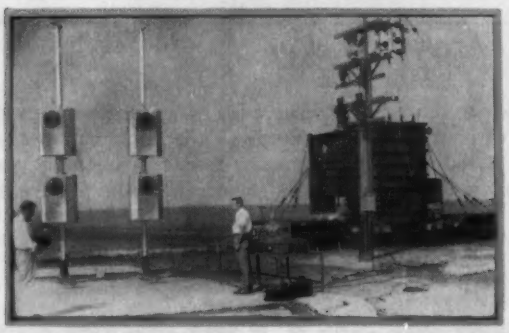
After careful study of the area, Allis-Chalmers designed and built a unit with frequencies melded to the ambient.

In addition, tests show that such factors as temperature rise, auxiliary losses and operating efficiency are extremely favorable.

This installation is assurance that, where low noise level is important, you can look to Allis-Chalmers.

Transformers like this are an outgrowth of continued research by Allis-Chalmers into magnetostriction and resonance in the A-C Sound Laboratories, the Mobile Research Unit and the Acoustical Proving Ground.

For help in finding the best and most economical means for solving a sound problem, contact your nearby A-C office. Or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.



Ten-acre acoustical proving ground provides first *practical* means for sound-level testing. Equipment on hand includes means for duplication of any area acoustically.

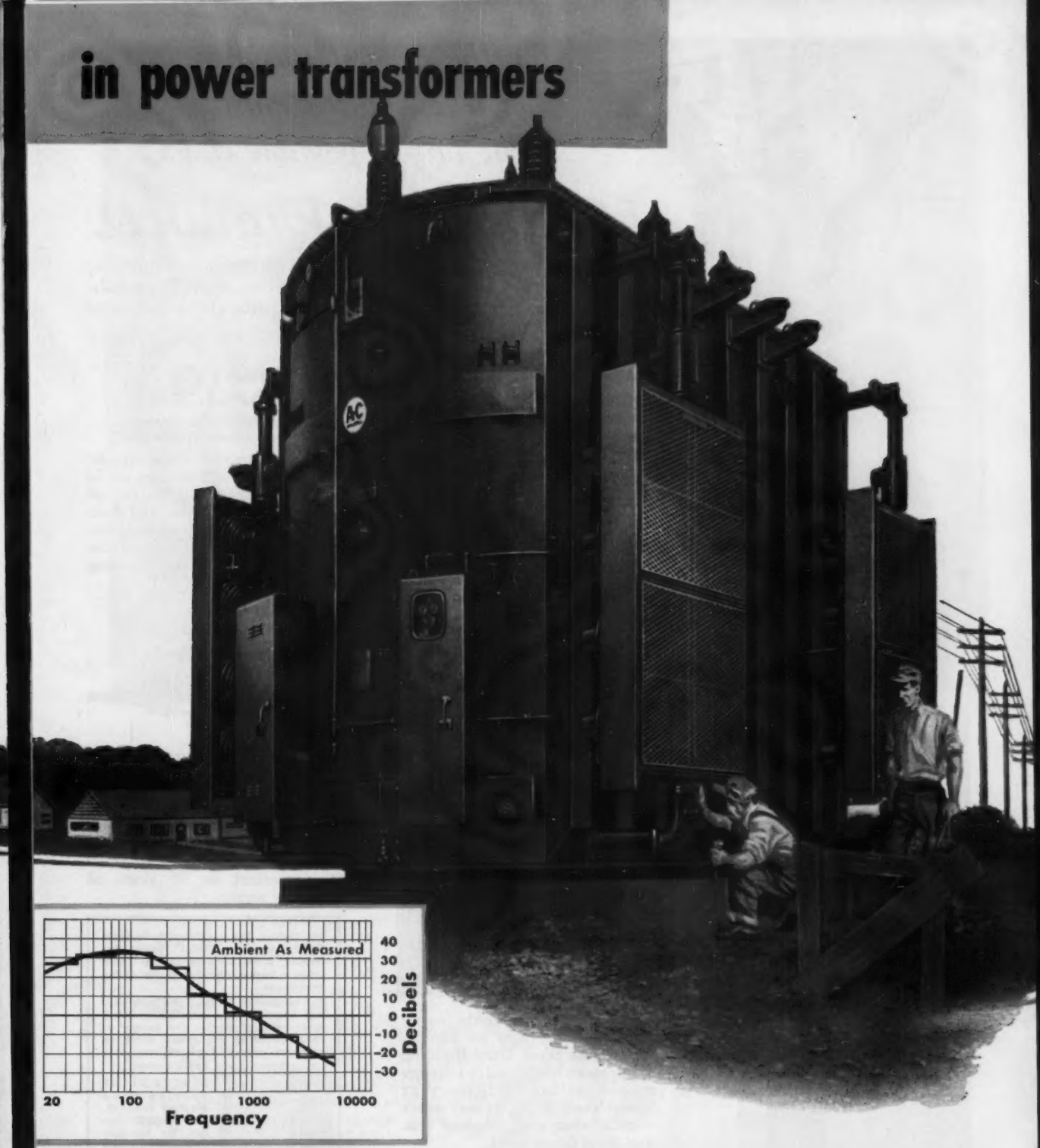
Mobile sound research laboratory unit can bring laboratory equipment to where substations are planned . . . helps you decide sound level of transformer.

A-5225

A-C ALLIS-CHALMERS

ALLIS-

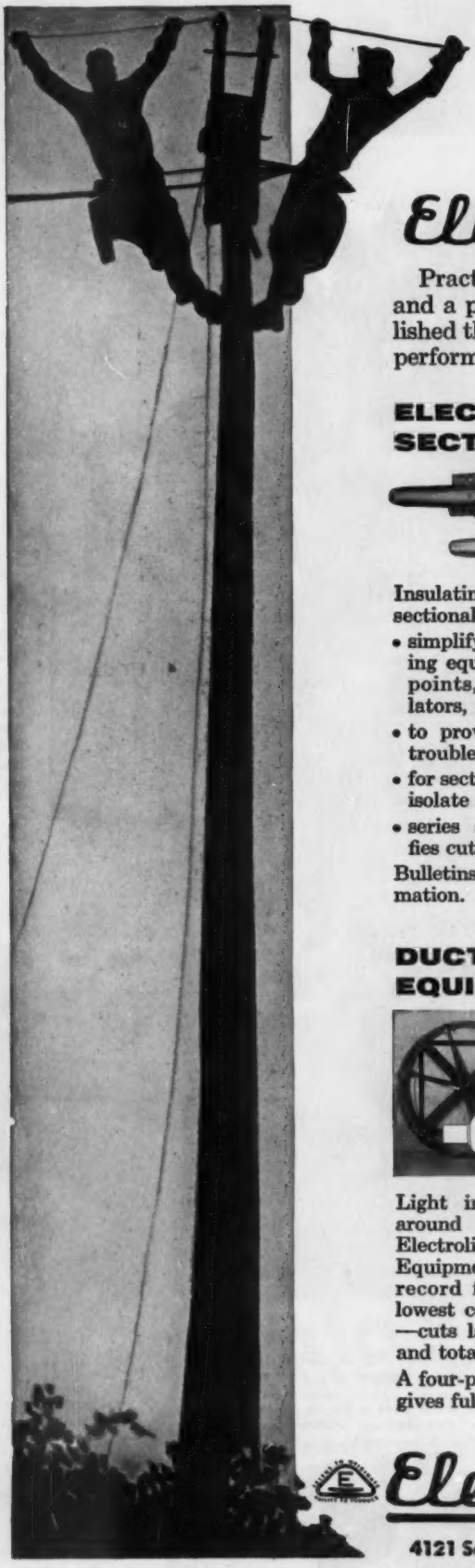
in power transformers



Testing at 2:00 a.m. determined maximum masking noises . . . helped determine noise level which transformer could have without creating complaints from nearby residences.

Low sound level is feature of new 125,000-kva Allis-Chalmers transformer being installed in residential area.

CHALMERS

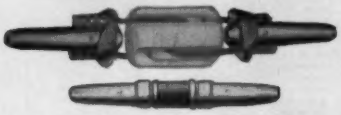


for the largest number of line applications, at the lowest possible cost . . .

Electroline Products

Practical experience designed these Electroline Products; and a practical habit of keeping close tab on costs has established them as first in the field—for top quality and economical performance.

ELECTROLINE SECTIONALIZERS

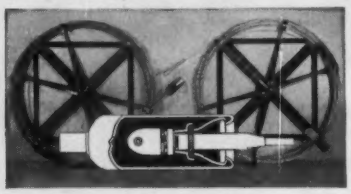


Insulating automatic line splice sectionalizers:

- simplify cutting-in of regulating equipment—disconnecting points, fuses, voltage regulators, series capacitors, etc.
- to provide points to test for trouble
- for sectionalizing networks—to isolate and test area in trouble
- series street lighting—simplifies cutting-in series lamps

Bulletins contain complete information.

DUCT-RODDING EQUIPMENT



Light in weight, feeds easily around bends, easy to handle. Electroline Steel Duct-Rodding Equipment has an extraordinary record for high efficiency at lowest cost. A big money-saver—cuts labor cost, original cost and total investment.

A four-page illustrated brochure gives full information.

AUTOMATIC LINE SPLICES

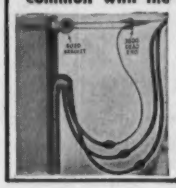
It is well said of these simple, rugged units—"They go on in no time; they hang on for all time." Easy to install—and their mechanical strength exceeds the rated breaking strength of the conductors. Ideal for restoring service.

AUTOMATIC DEAD-ENDS

In a typical "torture" test for strength, gripping and vibration damping features, 100,125,000 recorded vibrations did not develop any sign of failure of conductor in these rugged dependable Dead-Ends. Engineers call it equivalent to 50 years of ordinary service.

Electroline Service-Drop Automatic Dead End. The "3800" Series for holding pre-assembled service cable using a bare neutral conductor as the messenger.

The method of gripping the bare neutral employed by this ELECTROLINE Anchorage eliminates the danger of short circuiting the phase wires so common with the use of concentric cable clamps.



ELECTROLINE Service-Drop Anchor Bracket. The "4000" Series for securely supporting the cable at any angle.

Electroline Company

4121 So. LaSalle St., Chicago 9, Ill. In Canada: POWERLITE DEVICES, LTD., TORONTO

Photo courtesy Public Service Co. of Oklahoma

He's Using an "Idea Amplifier" to solve a cost-cutting problem

This Load Dispatcher's aim at the moment is to coordinate regulation of hydro and steam generation. On paper at least, this coordination contributes to lowest-cost operation, but in actual practice, its execution involves numerous factors —many of them variables, and far too complex to be calculated manually in a hurry.

So the Dispatcher turns to electronics for amplification and execution of his idea. He uses the console in front of him to convert it to an electrical equivalent which is instantly calculated and telemetered in the form of control pulses to any given number of turbine governor motors simultaneously . . . and it's all done with cost-cutting accuracy beyond the ability of even the best manual operation.

The "amplifier" in this case is an Area Load Control console—a device with computing circuits that functions as the brain of each Leeds & Northrup Area Load Control system. Already, these custom-engineered systems are installed on utility networks accounting for nearly a *third* of American generation.

Operating flexibility of Area Load Control is one reason for this preference. For when day-to-day operating conditions change (due to wet coal, loss of a cooling fan, unscheduled maintenance, etc.) Area Load Control provides the Load Dispatcher with the necessary flexibility to meet these problems as they arise.

Next time you have an opportunity, talk with your power neighbors who use Area Control—get the benefit of their thinking plus the ideas of your own operating staff. It's a method for turning in cost-cutting recommendations that work.

John Harrell, Manager Voltage Regulator Sales, points out that URL-16 feeder regulator with new CVR relay and instant-response Geneva gear tap changer combine to offer superior regulation with less maintenance.

Westinghouse 16-step regulation means you carry greatest load, produce most revenue

URL-16 with new CVR relay performs three exclusive functions:

1. FASTER CORRECTION OUTSIDE SET BANDWIDTH

The new CVR relay designed with inverse time characteristics actually evaluates the need for speed of response . . . steep voltage variations are corrected more quickly than gradual voltage changes. Result —a narrower effective bandwidth.

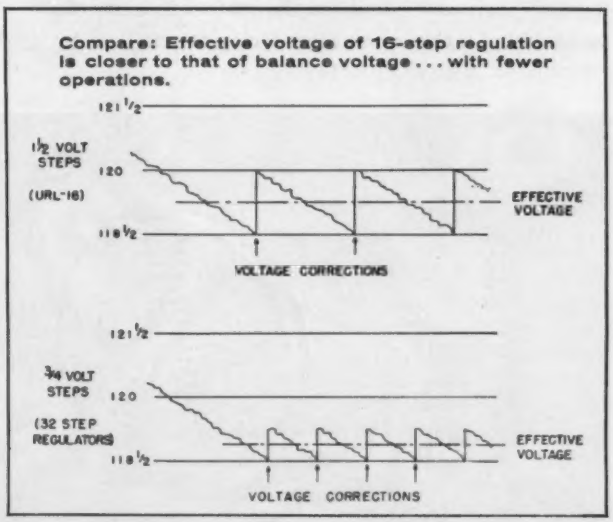
2. INSTANT-RESPONSE TAP CHANGING

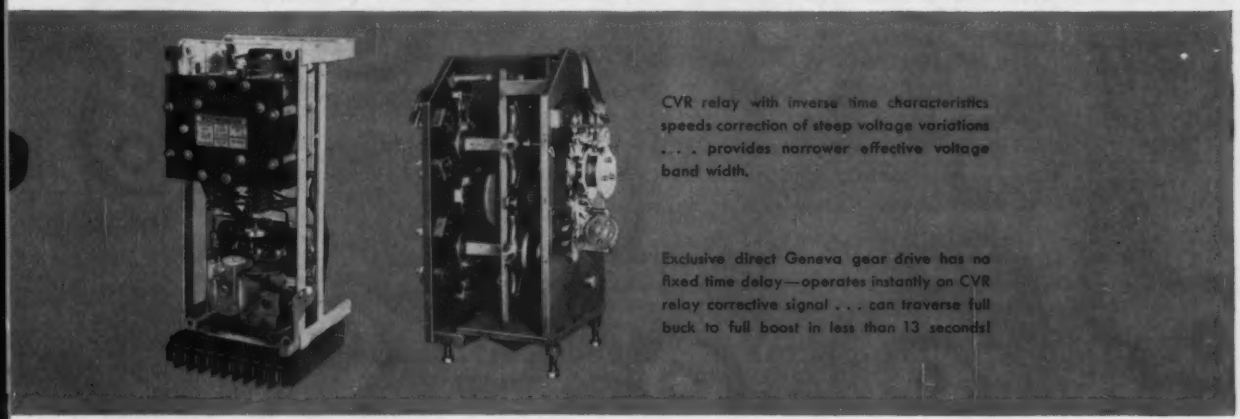
Because of direct Geneva gear drive there is no fixed time delay between relay and tap-changer operation. Tap changer operates instantly . . . can traverse full buck to full boost in less than 13 seconds!

3. 16-STEP REGULATION

The exclusive URL-16 with 1½-volt steps corrects exactly to balance voltage on a 3-volt bandwidth bringing the effective voltage nearer to this level. Similarly, the higher correction on 2-volt or greater bandwidth results in effective voltage closer to the desired level. URL-16 slashes number of corrective operations by 42%, contacts erosion 15%. Result—substantial savings in maintenance.

A narrower effective bandwidth means you can put more load on your system . . . get more revenue for power delivered. Specify new Westinghouse URL-16 regulators on your system. J-70779-X





CVR relay with inverse time characteristics speeds correction of steep voltage variations . . . provides narrower effective voltage band width.

Exclusive direct Geneva gear drive has no fixed time delay—operates instantly on CVR relay corrective signal . . . can traverse full buck to full boost in less than 13 seconds!

YOU CAN BE SURE...IF IT'S Westinghouse

Mallory Contact Design Service

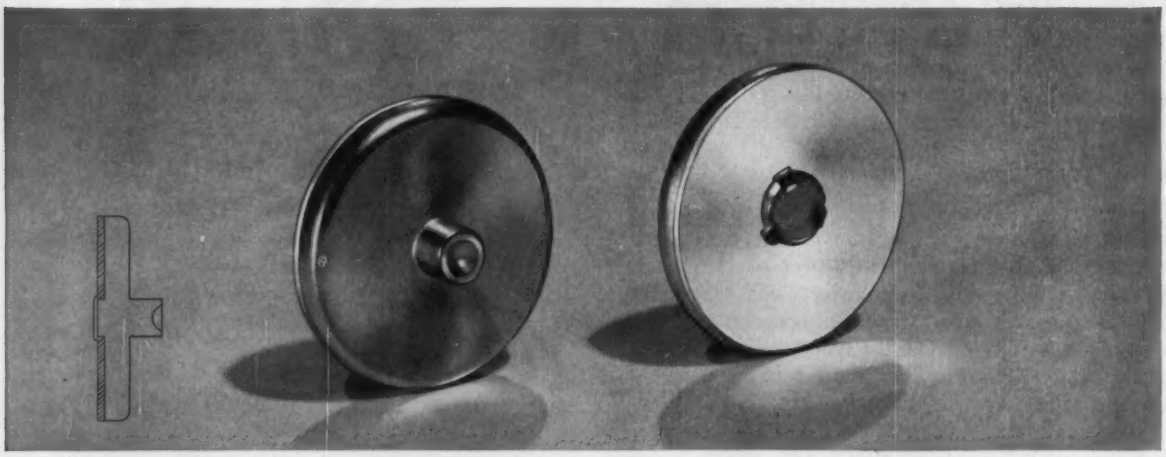
Saved 40%

for an automotive relay manufacturer

A manufacturer of automotive-type relays required a contact disc for a new component. The original design called for a screw-machined blank one-half inch in diameter, with a silver alloy disc brazed to the base.

Investigation revealed the cost of the contact made in that manner would be beyond budget. Mallory contact engineers redesigned the contact to allow the assembly of a thin silver alloy facing on the base by crimping instead of brazing. A locating projection on the blank holds the contact disc in place.

Prices based on the Mallory method of contact assembly were submitted to the manufacturer. Evaluation proved the design acceptable—the cost analysis proved a 40% saving over the original design—the manufacturer was able to develop the relay product within its acceptable cost limits.



Five MALLORY keys to economy through contact engineering

1. **The most effective** contact material from the extensive line developed by Mallory. More economical alloys often can satisfy *actual* service conditions.
2. **The most economical** contact design . . . for your purchasing, production and product needs.
3. **The most economical** backing material . . . from a group of Mallory alloys developed for this use.
4. **The most economical** backing member design in relation to contact and product design requirements.
5. **The most economical** method of assembling contact and backing member.

By coordinating *all* these important elements of contact design, Mallory can help you put into effect a long-range plan for cutting contact cost and assuring peak performance.

Write or call Mallory for consultation

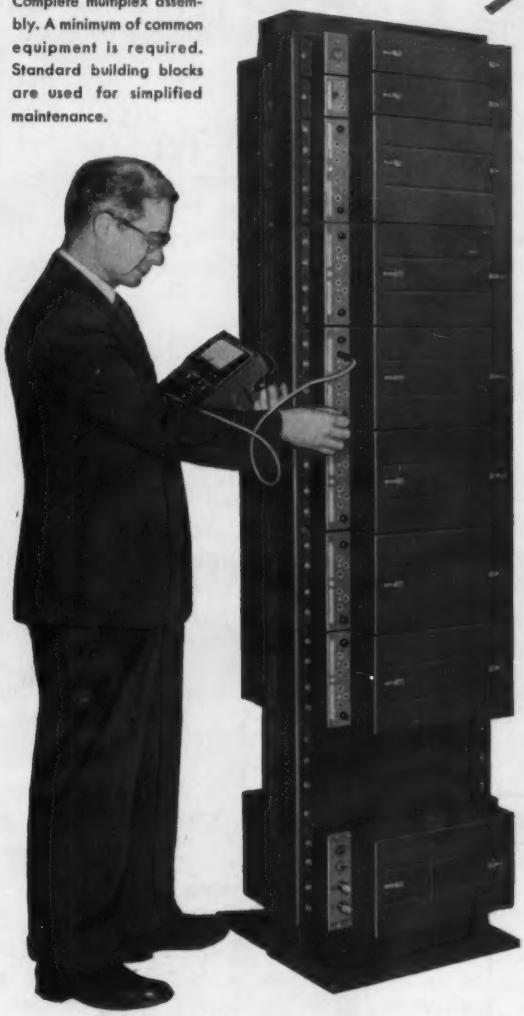
Serving Industry with These Products:

Electromechanical—Resistors • Switches • Tuning Devices • Vibrators
Electrochemical—Capacitors • Mercury and Zinc-Carbon Batteries
Metallurgical—Contacts • Special Metals • Welding Materials

P. R. MALLORY & CO. Inc.
MALLORY
P. R. MALLORY & CO. Inc., INDIANAPOLIS 6, INDIANA

NOW... Big News in Microwave Multiplex Channeling Equipment!

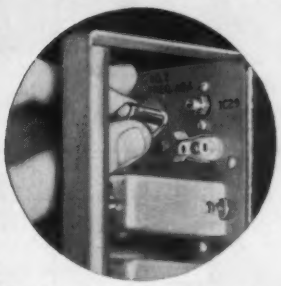
Complete multiplex assembly. A minimum of common equipment is required. Standard building blocks are used for simplified maintenance.



New RCA Type MV-124 with All Channel Units Identical and Interchangeable

Specifically designed for microwave use and thoroughly field tested, this new RCA Channeling Equipment provides complete flexibility. Frequency selection is by means of a plug-in crystal. Except for this crystal, *all Channel Units are identical and interchangeable*, thus simplifying planning, installation and maintenance.

Whatever your channeling requirements, these famous quality Channel Units can be easily stacked to provide two channels, three channels, or up to 24 voice channels without group modulating. High capacity systems can be obtained by stacking 24 channel groups. One unit is required for each voice channel desired. Single sideband suppressed carrier techniques are used to supply 24 channels in the band between 10 kc and 130 kc frequency, leaving frequency space for 18 tone channels below 10 kc. Simultaneous transmission of many channels of intelligence is accomplished by modulating separate sub-carriers spaced uniformly throughout the base-band modulating system. Channels are spaced one above the other in the available modulating band width.



To change channel assignment, simply change one plug-in crystal.

CRYSTAL CONTROL assures high stability and greater accuracy. For operations such as frequency shift telegraph and facsimile transmissions, an unusually high degree of clarity is attained.

DOUBLE HETERODYNING enables all circuits in all units to be identical except for the plug-in crystal element.

SINGLE SIDEBAND OPERATION enables each channel to use a minimum of spectrum space. This means less obsolescence due to possible congestion of the available microwave spectrum.

RCA Microwave . . . performance-proved in more than a million channel miles of operating systems throughout the world.

RCA Microwave Specialists will be glad to answer any questions and help plan your installation. Nation-wide services of the RCA Service Company are provided to keep entire system operating at its peak. Mail coupon for further particulars.

RADIO CORPORATION of AMERICA
COMMUNICATIONS PRODUCTS
Camden, N. J.

Radio Corporation of America
Communications Products, Dept. OC-45, Building 15-1, Camden, N. J.

Please send me the latest literature on:

☐ RCA Multiplex Channeling Equipment

☐ RCA Microwave for use in.....

Name.....Title.....

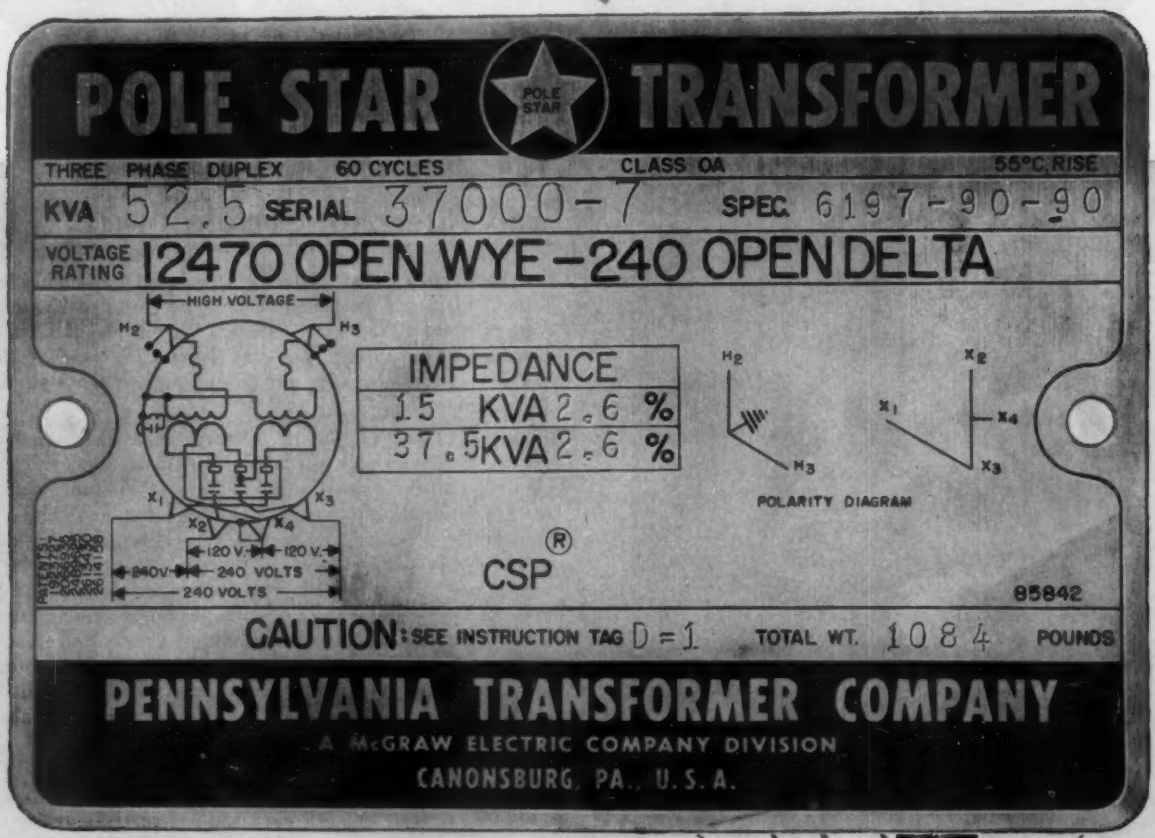
Company.....

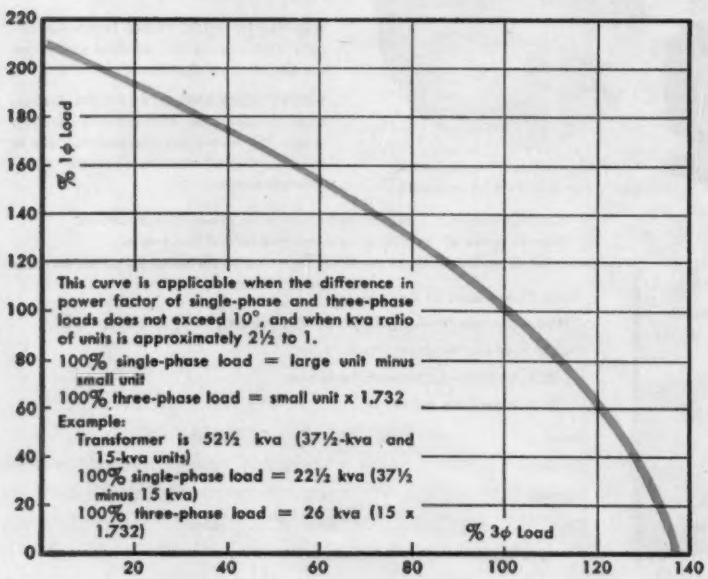
Address.....

City.....Zone.....State.....

☐ Have representative contact me.

Announcing the NEW





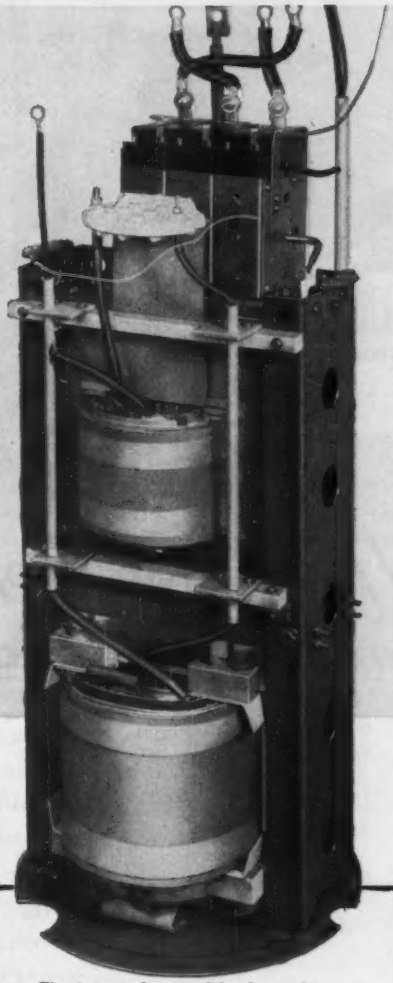
POLE STAR® DUPLEX TRANSFORMER

for Simultaneous Single- and Three-Phase Service from a Single Pole-Mounted Transformer

Pennsylvania's new Pole Star Duplex Transformers provide an efficient, economical answer wherever multiphase service is required from pole-mounted transformers. This is especially true in areas where three-phase air conditioners are used. By eliminating the need for banks of two or three units, Pole Star Duplexes simplify installation . . . lower initial costs. Mounted directly to the pole, the new duplexes require no extra cross-arms . . . make a neater appearance than do banks of transformers.

Pole Star Duplex Transformers are composed of two standard core-and-coil units mounted in a single tank — the most common combination being 37½ and 15-kva units to provide a total capacity of 52½ kva. The units are connected in open wye, open delta as shown on the opposite page, and may be equipped with CSP protective equipment.

Like all other Pole Stars, the new duplex transformers feature Pennsylvania's patented lap-on-top core. Thus, you can solve multiphase power problems and also get the low exciting current and low core loss for which Pole Stars are noted.



The internal assembly shown here is a 52½-kva Pole Star Duplex, formed by combining 37½-kva and 15-kva units. Other available ratings are: 20 kva (15 and 5 kva) . . . 35 kva (25 and 10 kva) . . . 40 kva (25 and 15 kva) . . . 62½ kva (37½ and 25 kva).

A Southwestern Utility Writes of These "Distinct Advantages" of Duplex Installations

1. "Their appearance is better. This becomes more and more important as the rapid increase in three-phase residential load requires more transformer installations very close together.
2. "In the event of trouble or overload on the secondary, all three phases will be interrupted by the CSP breaker*, not permitting single phasing due to secondary trouble.
3. "May be more readily installed on existing poles.
4. "More adaptable for use on poles where secondaries are dead-ended.
5. "Heat dissipation of large tank, common to both single-phase units, permits greater flexibility in overloading one or the other of the single-phase units."

**Pole Star Duplex Transformers are available either with or without CSP protective equipment.*

PENNSYLVANIA TRANSFORMER COMPANY

A McGraw Electric Company Division **CANONSBURG, PA.** *Greater Pittsburgh District*

The Best Performer

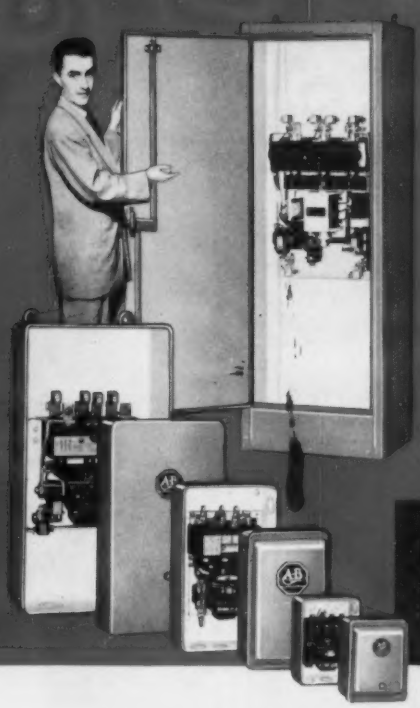
WORKS ENERGETICALLY BEHIND THE SET

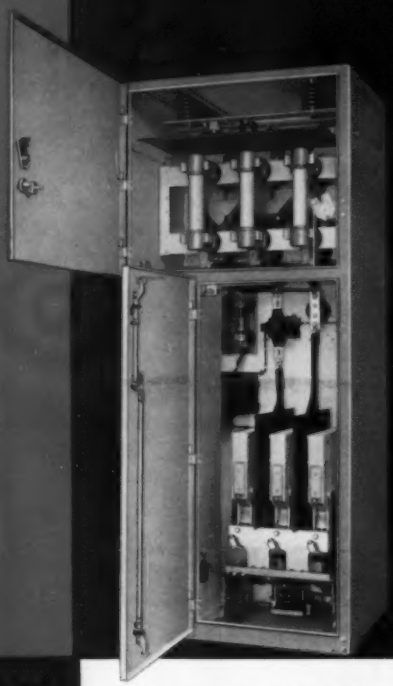
➔ You don't see it or hear it—it never takes a bow, but Bituminous coal is the power source behind most of your armchair entertainment. Fortunately for you the supply is practically limitless. Billions of tons of proved reserves in B&O fields alone provide a constant, low-cost supply of energy for hundreds of years. As modern marvels make life more enjoyable, *you can bet Bituminous is behind them,* serving efficiently and economically. *Ask our man!*

EXPERT ADVICE FROM OUR COAL TRAFFIC REPRESENTATIVES
on the right Bituminous energy source for any power requirements.
Contact Coal Traffic Department,
B & O RAILROAD, BALTIMORE 1, MD. LExington 9-0400

Baltimore & Ohio Railroad

a complete line—





Bulletin 709—LOW VOLTAGE
Eight sizes. Max ratings: 300 hp, 220 v; 600 hp, 440-550 v.

Bulletin 1159—HIGH VOLTAGE
Two sizes. Max ratings: 1500 hp, 2300 v; 2500 hp, 4600 v.

# of across-the-line Solenoid Starters

About 25 years ago, Allen-Bradley introduced the first modern *solenoid* starter . . . a revolutionary new design. Because of its simple construction and the resultant greater reliability, this starter became the model for the industry. Other manufacturers brought out solenoid starters in the lower ratings, but—only Allen-Bradley offers a full line of *eight* sizes. Like their smaller brothers, the higher rated starters provide an extremely long life and unfailing reliability.

Recently, Allen-Bradley announced a new line of high voltage starters—5000 volts, max—using the same reliable solenoid construction principles. These new air break starters have a mechanical life of millions of operations. Try them on your toughest high voltage applications and let yourself be surprised. Write for bulletin.

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

all have *DESIGN SIMPLICITY* for trouble free operation

- Only one moving part. No pins, pivots, or flexible jumpers.
- Double break, silver alloy contacts need no maintenance.
- Compact switch mechanism provides plenty of wiring space.
- Reliable overload relays protect the motor at all times.

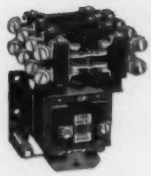
ALLEN-BRADLEY
MOTOR CONTROL
QUALITY

A-B Quality

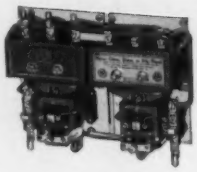
3-57-M

"we'll use ALLEN-BRADLEY Quality Motor Control ...it's trouble free!"

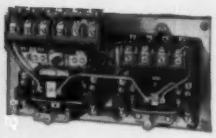
SPECIFY THESE RELIABLE MOTOR CONTROL UNITS



Bulletin 700
Universal Relay with
N.O.—N.C. Contacts



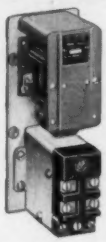
Bulletin 705 Size 2
Reversing Starter



Bulletin 715 Two
Speed Consequent
Pole Starter

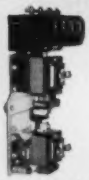
Bulletin 802T Adjustable
Lever Oiltight Limit
Switch

Bulletin 702 Three Pole
Size 2 Contactor



Bulletin 849 "On-Delay"
Pneumatic Timer

Bulletin 892
Handy Terminal
Blocks

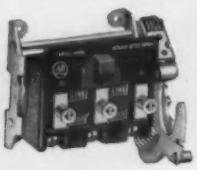


Bulletin 704, Mechanically
Held, Hum-free Relay

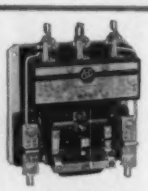
Bulletin 200
D-C Relay

Bulletin 350
Reversing Drum Switch

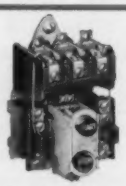
Bulletin 836
Pressure Control in
NEMA Type 4 Enclosure



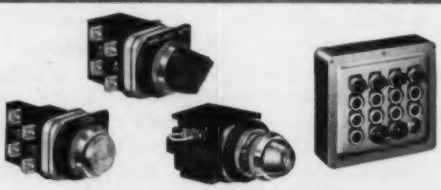
Bulletin 894
Visible Blade
Disconnect Switch



Bulletin 709
Size 4 Automatic
Starter



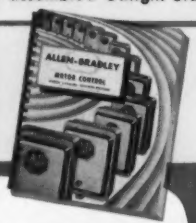
Bulletin 609
Three Phase
Manual Starter



Oiltight Push Button, Selector Switch, Press-to-Test
Pilot Light, and completely assembled Oiltight Station

Allen-Bradley *quality* components assure you millions of trouble free operations. The simple design, maintenance free, double break, silver alloy contacts, and rugged design features have made them the first choice among design engineers, contractors, and maintenance men. You just can't go wrong with this QUALITY line.

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.



Send for your copy of the new 7th edition of the Allen-Bradley Handy Catalog

3-57-MR

NEWS-SCOPE

FUTURE NEWS ▶

Watch for a forthcoming guide for easing engineering manpower problems. A subcommittee of EEI's Industrial Relations Committee is just completing preliminaries for launching a comprehensive study into many phases of the technical manpower situation as it affects electric utilities.

Good prospect for new AEC Commissioner is Dr Robert E. Wilson, chairman of Standard Oil Co of Indiana and member of AEC's general advisary committee. He would fill vacancy created by death of Dr Von Neumann recently. Some observers have Wilson pegged as possible future AEC chairman.

Average residential usage should climb about 260 kwhr this year. This would bring national average to 3,240 kwhr per customer per year.

LATE NEWS ▶

Interior Secy Fred Seaton recommends partnership development of California's Trinity River dam to Congress. Under proposal, Pacific G&E would spend $55.5 million to build power facilities at the $225-million, 384-Mw project and thereafter pay government for falling water. Project would yield surplus of $165 million in project revenues over 50-year term of pact and also provide $135 million in state, local, and federal taxes. Congress must approve proposal and specify what it wants done about preference.

Experimental boiling water reactor designed specifically for power production goes into operation at Argonne National Laboratory near Lemont, Ill.

Kidder Peabody & Co; Merrill Lynch, Pierce, Fenner & Beane; White Weld & Co; and Salomon Bros & Hutzler group wins $30-million Potomac Electric Power Co 4⅝% debentures due 1982 with a bid of 101.809%; reoffers at 102.62% to yield 4.45%.

One of largest steam plants in the West may be doubled. Pacific G&E has asked California PUC for okay to add two 325,000-kw generating units to its Pittsburg plant. The $83.2-million expansion would boost capacity to 1,310 Mw.

Washington gives green light to plans to install 15-million kw of nuclear power in France, Germany, Italy, Belgium, Holland, and Luxembourg within ten years. Program, under Euratom auspices, would make region world's leading nuclear power center at that time and would provide proving ground for U.S. atomic industry. U.S. government will provide atomic fuel; U.S. manufacturers will supply reactors and technical aid through direct export or on licensing basis.

Rep Sterling Cole (R-N.Y.), Joint AEC member, may introduce his own bill to speed reactor construction. It would be similar to last year's amended Gore Bill which provided that AEC reactor building be permissive, not mandatory, and that private capital could participate in federal reactor construction.

Building trade unions fail in recent attempt to reverse CIO-AFL's backing of Walter Reuther's fight against the PRDC reactor. AFL-CIO executive counsel still backs stand that reactor is unsafe and illegally authorized by AEC. Building trade unions seek jobs for members on this and other projects.

Government-backed bill now before British House of Commons would limit the Central Electricity Board's authority to manufacture heavy equipment—permitting such manufacture only where equipment could not be purchased elsewhere at a reasonable price.

ELECTRICAL WEEK

A TWO-MINUTE

STATION AUXILIARIES ▶ **What type of boiler feed pump shall it be** for your next large steam turbine unit? That's one of the hottest questions being tossed around by today's station designers. One thing is sure—there's no single, simple answer to this one. Authors contributing to this week's special report on steam station auxiliaries come up with some vital information as to how they evaluate and meet varied feed pump requirements **(p 77).** Examples:

For units ranging from 100 to 275 Mw and with 2,400-psi steam pressure and above, consideration must be given to other than motor drives for boiler feed pumps, say Engineers W. H. Borghesani and E. Carlson of Stone and Webster Engineering Corp. This comprehensive article, evaluating the various feed pump requirements for different station designs, comes up with some pointers that even the most knowledgeable designer may have overlooked **(p 78).**

If you really want to figure close in evaluating feed pump drives, Engineer R. F. Scheibel of Sargent & Lurdy urges that you try it on the basis of "net-send out" for a particular unit. He argues that this method cuts incremental cost estimates to a minimum and gives you a sounder basis for your calculations **(p 81).**

Shaft-end feed water pumps will save Public Service Electric & Gas around half a million dollars on an auxiliary power system, writes D. W. Taylor. The utility will install a half-size, 8,500-rpm, centrifugal-type pump on each shaft of its two new 290-Mw, cross-compound units at Bergen Station. A single motor-driven pump for starting is provided for each unit **(p 86).**

But Detroit Edison sticks with motor-driven pumps for its ultra-large, 320-Mw River Rouge Unit No. 3, writes W. W. Brown. Its auxiliary power system at 4,160 and 480 v will be split into two parts of about equal size, each fed by a separate bus **(p 88).**

And Con Edison will use a full-size turbine-driven feed pump, backed up with a couple of half-size motor driven units for its Astoria No. 3, 335-Mw unit. J. G. Noest also sketches in some details of the auxiliary power system for the new Astoria unit **(p 90).**

To round out the special report, Electrical World's new associate editor, C. F. Hochgesang, bows in with an "anti-gadetry" article calling for a long, hard look at the desirability of providing for automatic transfer of auxiliary power systems to stand-by sources **(p 84).**

WASHINGTON ▶ **Florida electric utility men draw a bead on the oil industry** at Senate Committee hearings. They told the group that oil price boosts will cost electric power users some $30 million a year in Florida alone. Alan S. Boyd, chairman of the Florida Railroad and Public Utility Commission, called the increases "unconscionable" **(p 64).**

EVENTS ▶ **Coal pipe line 108 miles long bringing fuel from coal fields** to Cleveland Electric Illuminating's Eastlake Plant undergoes final tests this week **(p 62).**

Specially designed rates for customers served from underground distribution systems have been approved by the California PUC. They are to apply where the utility is required to furnish underground service in excess of its normal practice **(p 63).**

What happens when the transmission grids of eastern and central U. S. are tied in with the western system. The tie lasted six minutes, then . . . **(p 65).**

"Willie Wiredhand," the rural electric cooperatives' symbol for electric service, is in business to stay. A federal appeals court ruled "Willie" was not an "infringement or confusingly similar" to Reddy Kilowatt **(p 68).**

PREVIEW OF THIS WEEK'S ELECTRICAL WORLD

SUBSTATIONS ▶ **You can get about the same capacitor bank protection** by using an air-break switch as by an oil circuit breaker, contends L. F. Meisenheimer, operating engineer for Duke Power Co. He describes switching tests on capacitor banks up to 6,000 kvar at 44 kv **(p 95).**

DISTRIBUTION ▶ **Scheme for mounting 12 50-kvar capacitor units on a single pole** has been worked out by Dayton P&L. These capacitor clusters are on circuits where the fault duty is less than 5,000 amp. They are fused in groups of four **(p 102).**

SELLING ▶ **"Light for Living",** the specially designed residential lighting promotion program being tried by Kansas G&E and Mississippi P&L, added 30 watts of home lighting per customer in the two areas last year. One company's promotion team sold 1,095 kw of new lighting load last year—about twice as much as it had sold in 1955. The other company's promotion team added 852.5 kw of lighting load last year—about triple the previous year's results **(p 112).**

Higher egg production, lower mortality rates for hens resulted when a poultry ranch in Texas installed evaporative air cooling in the chicken house **(p 115)** . . . And in Texas, too, San Antonio's newest shopping center boasts air conditioned sidewalks. If you don't believe it, take a look at the picture **(on p 116).**

MANAGEMENT ▶ **Don't bank on lower interest rates before mid-year,** and don't count too much on them even then. Best advice for offering new securities: make sure your issue isn't bunched with a lot of others **(p 67).**

How much can you allow in the way of substation equipment, spur lines, and reinforcement of distribution facilities to add a large industrial customer? If you rely on the old rule-of-thumb method of "three times the estimated annual revenue" you may be losing your shirt on the deal. Better take a look at the charts which consulting engineer Hans E. Nissel has drawn up to give you a quick, sounder method of adding net as you add revenue **(p 74).**

PEOPLE ▶ **Daniel A. Campbell, Jr,** is new general superintendent of Pennsylvania Power & Light Co succeeding Warren J. D. Geary, retired . . . Newly appointed treasurer of Sierra Pacific Power Co is Roy Torvinen who joined the utility 26 years ago as chief clerk . . . R. A. Holdcraft moves up to become assistant treasurer . . . M. R. Rodger and R. M. Winsborough are new vice presidents at Middle West Service Co **(p 166).**

MANUFACTURERS ▶ **Bank of 345-kv air switches is now in service** at each end of Bonneville Power Administration's 175-mile McNary-Ross line which brings hydro power to Portland, Ore. Having a rating of 1,600 amp continuous current, 70,000 amp momentary, and 1,300-kv BIL, these switches are reportedly among the first in the U. S. to be operated at the extra high transmission voltage **(p 146)** . . . An impulse generator, rated 1.4-million volts with discharge of 16 kw-sec, has been put into service at the Simplex Wire & Cable laboratory. This installation will permit studies covering variations in mechanical construction of cable and insulating values of covering materials **(p 146).**

NEW EQUIPMENT ▶ **New addition to a watthour demand meter line** uses a single-phase watt-hour unit to record kwhr and logarithmic thermal unit for kva demand. With a constant load, the demand unit is said to reach 90% of the final reading in 15 min. Meter is rated 240 v, 15 amp, 60 cps, 3-wire, single-phase for maximum demand of 24 kva **(p 120).**

ENGINEERING TRENDS

Cascade-connected units will make high-voltage potential transformers, stacked like lightning arresters to match voltage requirements, in a forth-coming new design. Compensating windings will enable the stack to meet 0.3 class accuracy standards. And at 230 kv the new design will provide 1,050 BIL in ⅔ the height of conventional units as a substantial savings.

Availability factor for turbines above 1,350 psi has averaged 89.64%, according to an AIEE subcommittee's 5-year survey. Boilers for steam at this pressure have been 88.84% available. Comparable figures for machines of 20 Mw or more (over 10 Mw for superposed units) are 93.2% for 700-1,000 psi and 91.95% for 1,000-1,350 psi. The boilers for these pressures averaged 91.79% and 89.66%, respectively.

Crushed rock backfill for pole holes increases resistance to uplift. But too coarse a size impairs this effect, according to discussions at the recent AIEE sessions where it was revealed that stones larger than 1 in. give transmission poles less support than smaller sizes of stone.

Underground gasification of coal gains further status in Britain where the National Coal Board has appointed consultants and contractors to provide fuel by ignition of unmineable coal for a pilot power plant. The next step will be a 60-Mw station to burn about 1,000 tons per day of coal in the ground, according to *Electric Journal.*

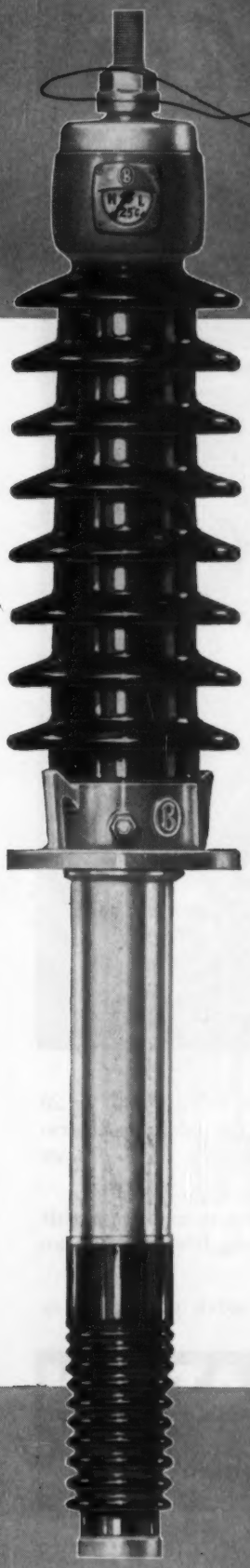
Electronic relaying will gain converts with the use of transistors in lieu of the former vacuum tubes. Another application of electronics in the electrical business is use of a tape recorder by General Electric Co to report Social Security deductions from its employees to the Internal Revenue Dept. One 2,400-ft tape (every 3 months) supplants upwards of 900 typewritten pages of names.

Nuclear fuel will provide Britain as much electricity as all present sources by 1975, and possibly twice as much. *Power & Works Engineering* attributes to Lord Privy Seal Butler the statement that this nuclear output will be equivalent to that of 50 to 100 tons of coal per year.

Ultrasonic testing may supplant coring of concrete structures to test the quality of the mix. As now used by Southern California Edison Co, it gives useful results faster and cuts the cost and destruction associated with the former method.

Dc transmission at 220 kv will link Britain and France via a single cable, according to *Electrical Review.* This $10 million project to be completed in 1960 will carry 120 to 150 Mw.

Transmission voltage is rising in Africa, too, Southern Rhodesia will use 330 kv for a 760-mi project and the output of Australia's Snowy Mountain underground hydro plant at 4,500-ft altitude will be transmitted at the same voltage, reports *Electric Journal.*



BUSHING STANDARDS CAN CONSERVE CAPITAL

Purchasing and Management have a special stake in ASA bushing standards. These standards, when in effect, will open new opportunities for conserving invested capital and for control of operating costs.

Formerly, bushings were custom-built, usually for a specific transformer or circuit breaker. Major equipment required service protection in the form of a spare bushing, purchased as part of the new equipment, and retained in inventory. Multiply this by the number of pieces of equipment on a system -- recognizing that bushings are far from cheap -- and you have a sizeable investment.

In many cases, reserve bushings are never used. But, being built for a specific purpose, they become obsolete when their "parent" apparatus is retired. Therefore, after years of eating-up capital, they are finally scrapped at a dead loss.

If this condition were infrequent, or if the dollars involved were few, it would be of little consequence. Unfortunately, quite the opposite has been the case, as your own experience will probably prove better than any argument we can present.

Under the ASA bushing standard, variety will be drastically reduced and the remaining models will be completely interchangeable. Instead of one bushing protecting one piece of equipment, this one can protect many pieces of any given voltage rating, and the total spare bushing investment will shrink drastically.

These spare bushings will be universally applicable regardless of who made either the bushings or the station apparatus. Life of these spares will be indefinite, and their number need not increase, as they will fit both existing and future equipment.

Since standardized bushings are typified by reduced diameters, they will almost always fit the larger clearances of older apparatus. Therefore, their broad protective values will not be delayed until a system is completely modernized.

Presently, the ASA standard is in effect up to voltage ratings of 69 kv. Extension of the standard to all higher voltages is imminent. But, when such standards are fully adopted, it is not necessarily true that all their virtues will be automatic. Standards are not mandatory. They are only a means to an end. This end, in our opinion, is tremendously worthwhile, but it will never be effected without proper support. Such support can come only from individual electric power companies in the form of definite specification of the ASA standard.

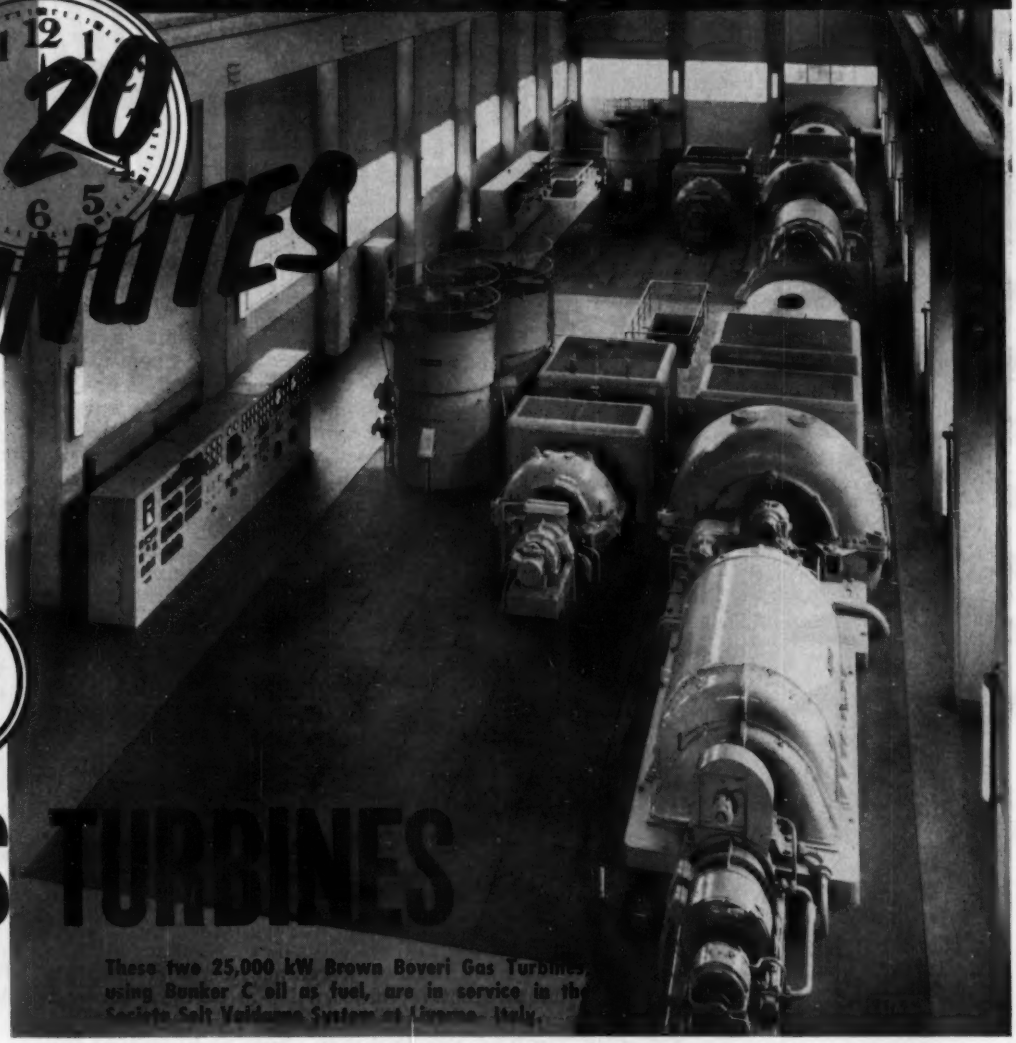
Bear in mind, however, that standards control only the physical aspects of a bushing and not in the slightest degree its reliability or performance. These have reached the highest level in our experience of nearly 50 years in the new line of ASA standard bushings produced by the Ohio Brass Company.

OHIO BRASS COMPANY, MANSFIELD, OHIO

4790-H

Ohio Brass

ON THE LINE IN 20 MINUTES



These two 25,000 kW Brown Boveri Gas Turbines, using Bunker C oil as fuel, are in service in the Società Solt Valdarno System at Livorno, Italy.

BROWN BOVERI

GAS TURBINES

BROWN BOVERI large output gas turbines go into operation at full load *in 20 minutes or less* from a cold start. That's why they are so ideal for peak load service. Operating experience with Brown Boveri gas turbines shows a 25% *proven* efficiency . . . a new standard for performance and economy.

First costs of gas turbine power plants are substantially lower than comparable conventional power plants. Further economies are realized in long life, low operating costs and low maintenance.

Discover how Brown Boveri large output gas turbines can solve your peak or base load problems. Write for the facts, today.

BROWN BOVERI CORPORATION

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Atlanta, Ga. • Birmingham, Ala. • Boston, Mass. • Buffalo, N. Y. • Butte, Mont. • Chicago, Ill. • Cleveland, O. • Denver, Colo. • Detroit, Mich. • Hamilton, O. • High Point, N. C. • Houston, Tex. • Jacksonville, Fla. • Kansas City, Mo. • Knoxville, Tenn. • Lewiston, Me. • Miami, Fla. • Minneapolis, Minn. • New Orleans, La. • New York, N. Y. • Pasadena, Cal. • Portland, Ore. • Roanoke, Va. • San Francisco, Cal. • Seattle, Wash. • Syracuse, N. Y. • Tucson, Ariz.

No bending problem here, because...

ROEBLING PAPER POWER CABLE WITH TELLURIUM LEAD ALLOY SHEATH HAS 4½ TIMES GREATER BENDING LIFE!

Roebling electrical wires and cables are available with either copper or aluminum conductors.

Yes, Roebling Paper Power Cable with tellurium lead alloy sheath takes that much more bending punishment than cables with copper-bearing lead sheath! And that's been proved time and again, not only in Roebling's laboratory bending fatigue test machine, in which lengths of cable are literally bent to death, but in field use over extended periods.

The uniform character of every inch of sheath and its high resistance to age-hardening, plus its unique stability under heat, assure long life under unusually severe conditions.

But there's an "inside" story to this cable, too. For the superior properties of this sheath are combined with a carefully constructed and tested inner cable made to meet the most stringent use demands. That's why, more and more, this cable is specified by name wherever cable has to last a long, long time.

Write for the full, interesting story today!

ROEBLING

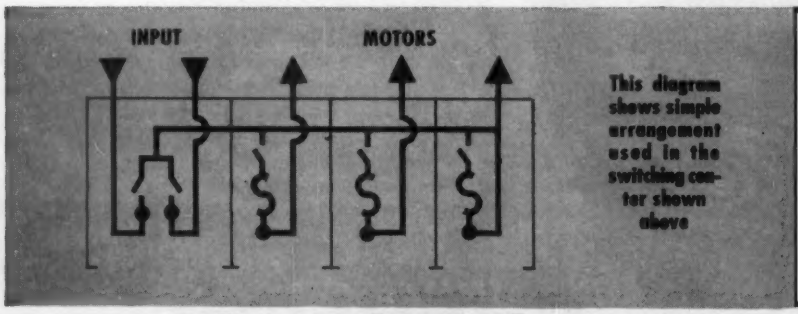
JOHN A. ROEBLING'S SONS CORPORATION
Trenton 2, N. J. • Branch Offices in Principal Cities
Subsidiary of The Colorado Fuel and Iron Corporation

The man with his coat off is Carl Christiansen, 3E Sales Engineer, pointing out the features of a 3E Switching Center built for a large automobile manufacturer.

3E builds to meet the specs . . .
. . . *no need to compromise*

3E engineering and standard components solve a wide range of unique requirements.
There is often a temptation to sacrifice a measure of efficient design in favor of easily available standard units. At 3E we believe that equipment engineered to fit job requirements without compromise is not only economical —it is the best way to protect *your responsibility for safe precise control of power.*

The switching center shown above was built for a major auto manufacturer. It is typical of the many cases where there is *no standard package* that can do the job. The unit handles a 4800 volt input distributed to two 300 H.P. motors and one 200 H.P. motor used to drive high frequency generators. The use of 3E's **Auto Speed Load Interrupter Switches** and 3E design produced a compact, rugged switching center at a practical cost.

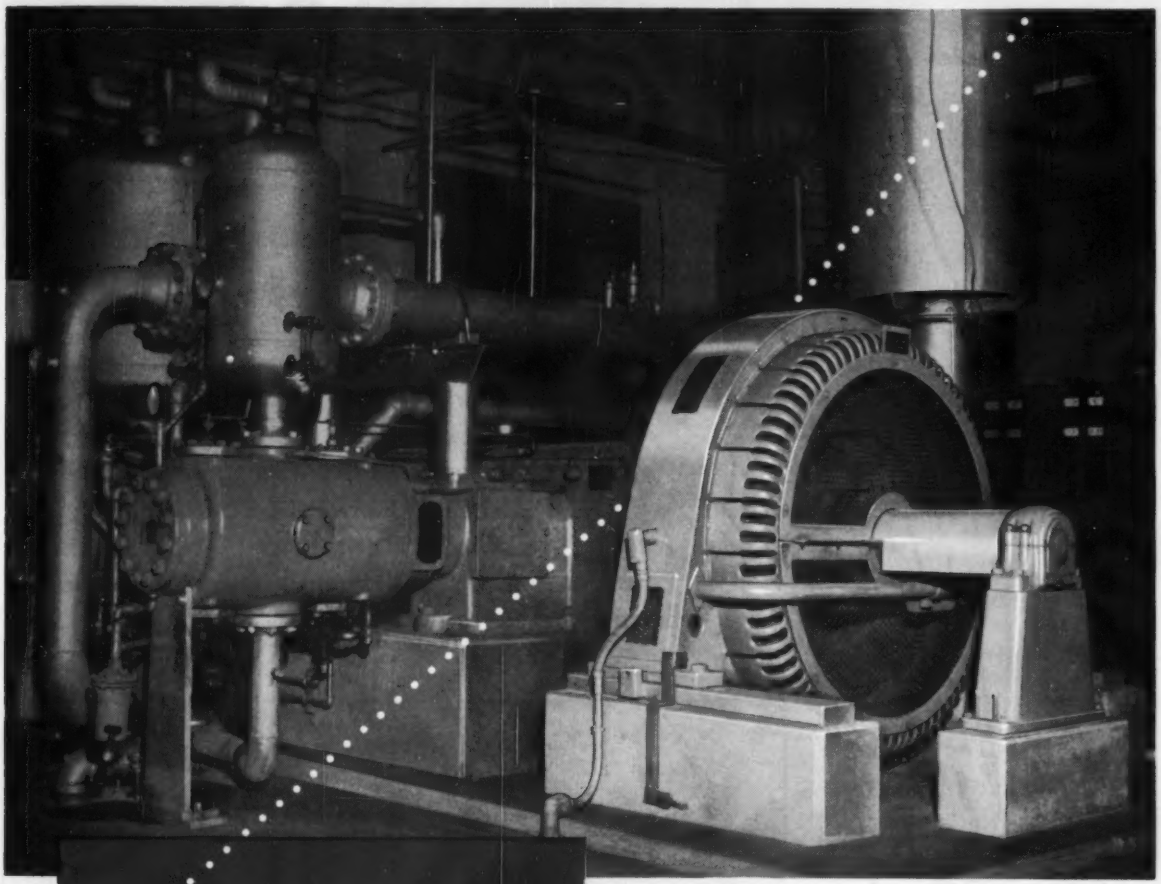


This diagram shows simple arrangement used in the switching center shown above

3E

ELECTRICAL ENGINEERS EQUIPMENT CO. Melrose Park, Illinois
Representatives in principal cities—in Canada by Power-Lite Devices, Ltd.

On big, important compressor drives, like this



ELLIOTT SYNCHRONOUS MOTORS

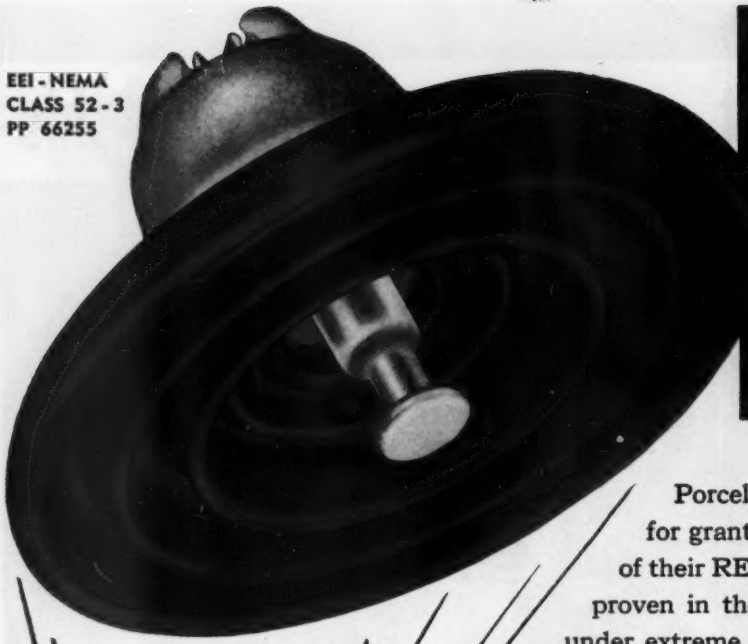
ONE OF THE WORLD'S LARGEST SOOT BLOWER COMPRESSOR INSTALLATIONS is located in the famous Joppa Steam Electric Station of Electric Energy, Inc. There are six giant soot blower compressors, like the one pictured above – all driven by large Elliott 800-hp, 400-rpm synchronous motors. These motors are engine type with modern split-rotor construction. As is the case with all Elliott synchronous motor installations, the application of the motors was done with great care and consideration of all the complexities which accompany modern compressor drives. Elliott experience in compressor drives of all sizes and types is second to none, as attested by hundreds of successful installations. Ask your Elliott field engineer or write to Elliott Company, Ridgway, Pa., for full details.

ELLIOTT Company

R6-7

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

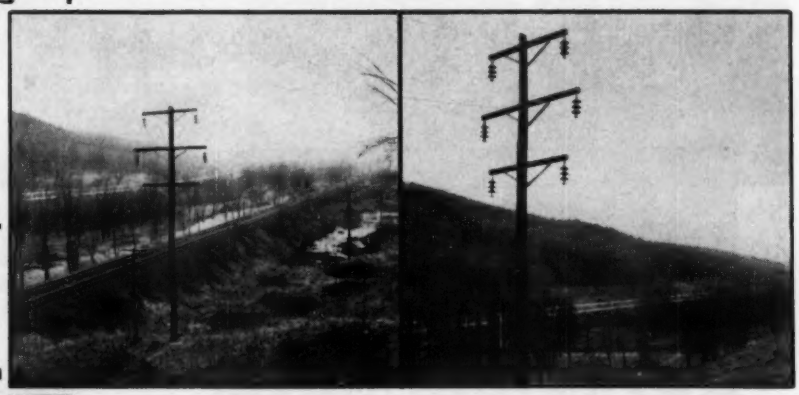
EEI - NEMA
CLASS 52 - 3
PP 66255



R R

Porcelain Products insulators are taken for granted — taken for granted because of their RECOGNIZED RELIABILITY — proven in the field for more than 63 years, under extreme and exacting conditions.

RECOGNIZED RELIABILITY is acknowledged by the continued widespread and increasing use of Porcelain Products Insulators — a product has to be good to achieve this distinction.



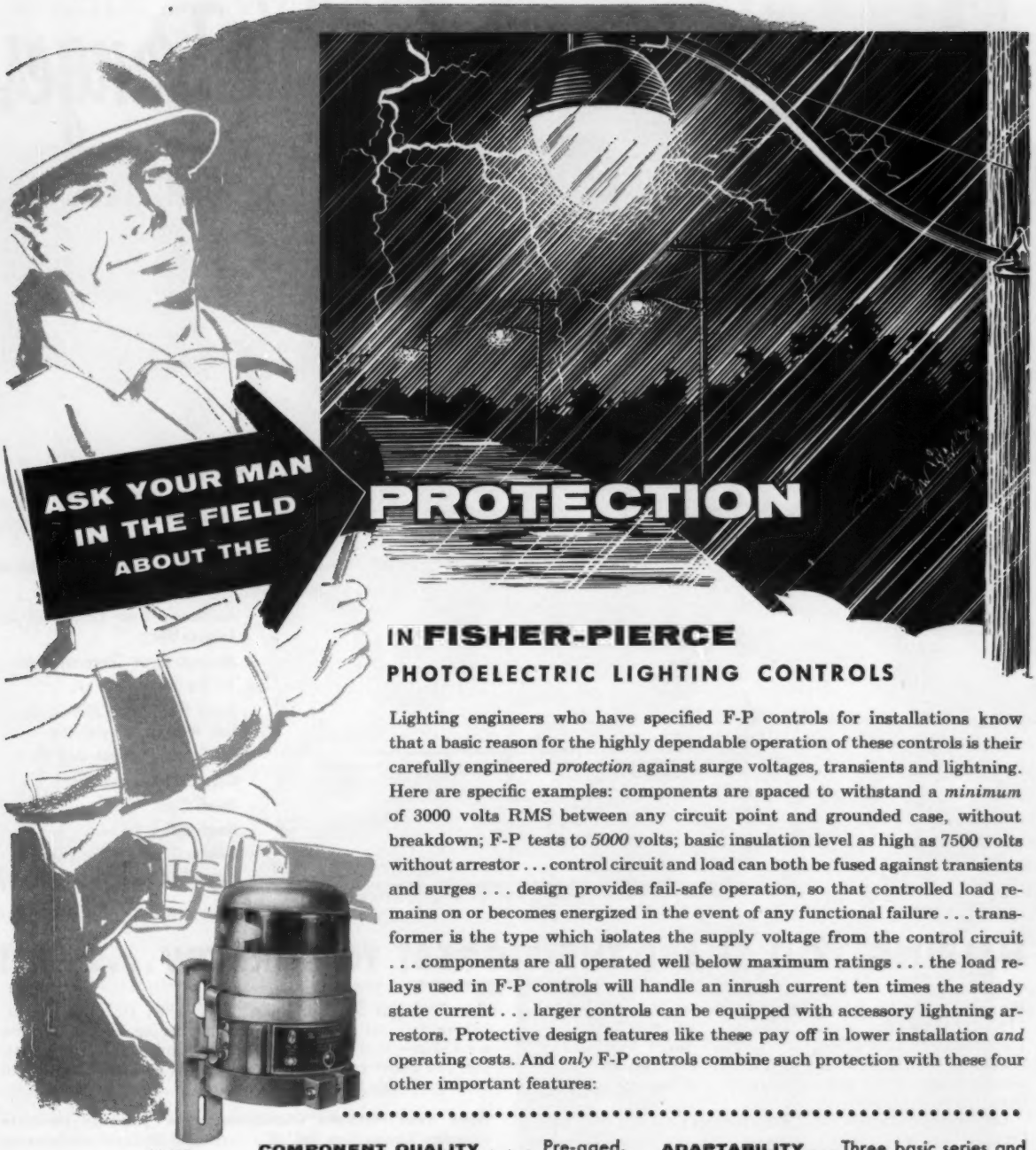
The New York Thruway, a real super, was built through the heart of the ROCKLAND LIGHT & POWER and the ORANGE & ROCKLAND ELECTRIC COMPANY power systems in the vicinity of Nyack, N. Y., precipitating major expansion and relocation problems of their power systems.

The Nyack area, now but 20 minutes from downtown N. Y. is realizing a tremendous program of industrial and residential development—placing enormous new demands on the power systems. Thousands of Porcelain Products Insulators are being used on this transmission expansion and relocation project—used because of their RECOGNIZED RELIABILITY.

PP INC.

Porcelain Products, Inc.

High Voltage Division
Parkersburg, W. Va.



IN FISHER-PIERCE
PHOTOELECTRIC LIGHTING CONTROLS

Lighting engineers who have specified F-P controls for installations know that a basic reason for the highly dependable operation of these controls is their carefully engineered *protection* against surge voltages, transients and lightning. Here are specific examples: components are spaced to withstand a *minimum* of 3000 volts RMS between any circuit point and grounded case, without breakdown; F-P tests to *5000* volts; basic insulation level as high as 7500 volts without arrestor . . . control circuit and load can both be fused against transients and surges . . . design provides fail-safe operation, so that controlled load remains on or becomes energized in the event of any functional failure . . . transformer is the type which isolates the supply voltage from the control circuit . . . components are all operated well below maximum ratings . . . the load relays used in F-P controls will handle an inrush current ten times the steady state current . . . larger controls can be equipped with accessory lightning arrestors. Protective design features like these pay off in lower installation *and* operating costs. And *only* F-P controls combine such protection with these four other important features:

64400

63300C

COMPONENT QUALITY . . . Pre-aged, long life tubes. Wire wound potentiometer. Metal encased and ceramic capacitors. Non-hygroscopic 1P39 phototube. Balanced armature Sigma sensitive relay.

DESIGN ADVANTAGES . . . Can be installed, serviced or removed safely and easily. Wide mounting versatility and orientation *after* bracket installation.

ADAPTABILITY . . . Three basic series and numerous models for all mounting requirements, operating voltages, load capacities and desired contact arrangements.

DEPENDABILITY . . . Proven by the thousands of F-P controls used by hundreds of utilities, over the past ten years.

Fisher-Pierce Bulletins, available upon request, give complete specifications and operating data.

THE FISHER-PIERCE CO., INC.
82 Pearl Street, So. Braintree, Boston 85, Mass.

Atlantic City Electric

DE LAVAL

Hotpoint Electric Ranges

women-tested features that build sales...load...revenue!

- "Fashion-Front" Styling
- Colortones
- Color-Lighted Pushbuttons
- Two-Way Super-Matic—Choice of 6″ or 8″ Unit
- Automatic Time Control of All Surface Units
- Musical Meat Thermometer
- 1½ Gallon Coffee-Perk
- Super Fast "Super 2600" Calrod® Unit • Silver Grey Ovens
- All-Calrod—Surface *and* Oven
- Rota-Grill Rotisserie
- Handi-Over Grill
- Handi-Raise Broiler
- Golden Griddle • Thrift Cooker
- Automatic Reset Oven Timer

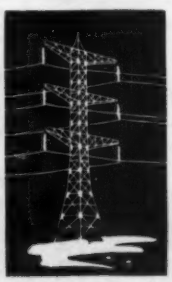
HELPING YOU SHAPE THE BIGGEST TOMORROW... EVER!

Here's the Electric Range that puts more *salespower* behind "HOUSEPOWER," more *living* in "LIVE BETTER . . . Electrically"! That's because Hotpoint made hundreds of studies to determine what your women customers want in an electric range—then designed models and features to specifically meet those demands!

Let Hotpoint Automatic Electric Ranges help you shape the biggest tomorrow—*ever!* Hotpoint's women-tested features offer the shortest distance between the sales floor and more electric ranges on your lines. And, when Hotpoint's hard-hitting national advertising and imaginative sales-promotion are tied-in with the "HOUSEPOWER" and "L.B.E." programs, you can boost your electric range sales, load and revenue to more profitable levels.

Have your Hotpoint Distributor show you the *complete* Hotpoint Range Line for '57 . . . 6 NEW 39-inch models and 3 NEW 30-inch models!

Again, Hotpoint



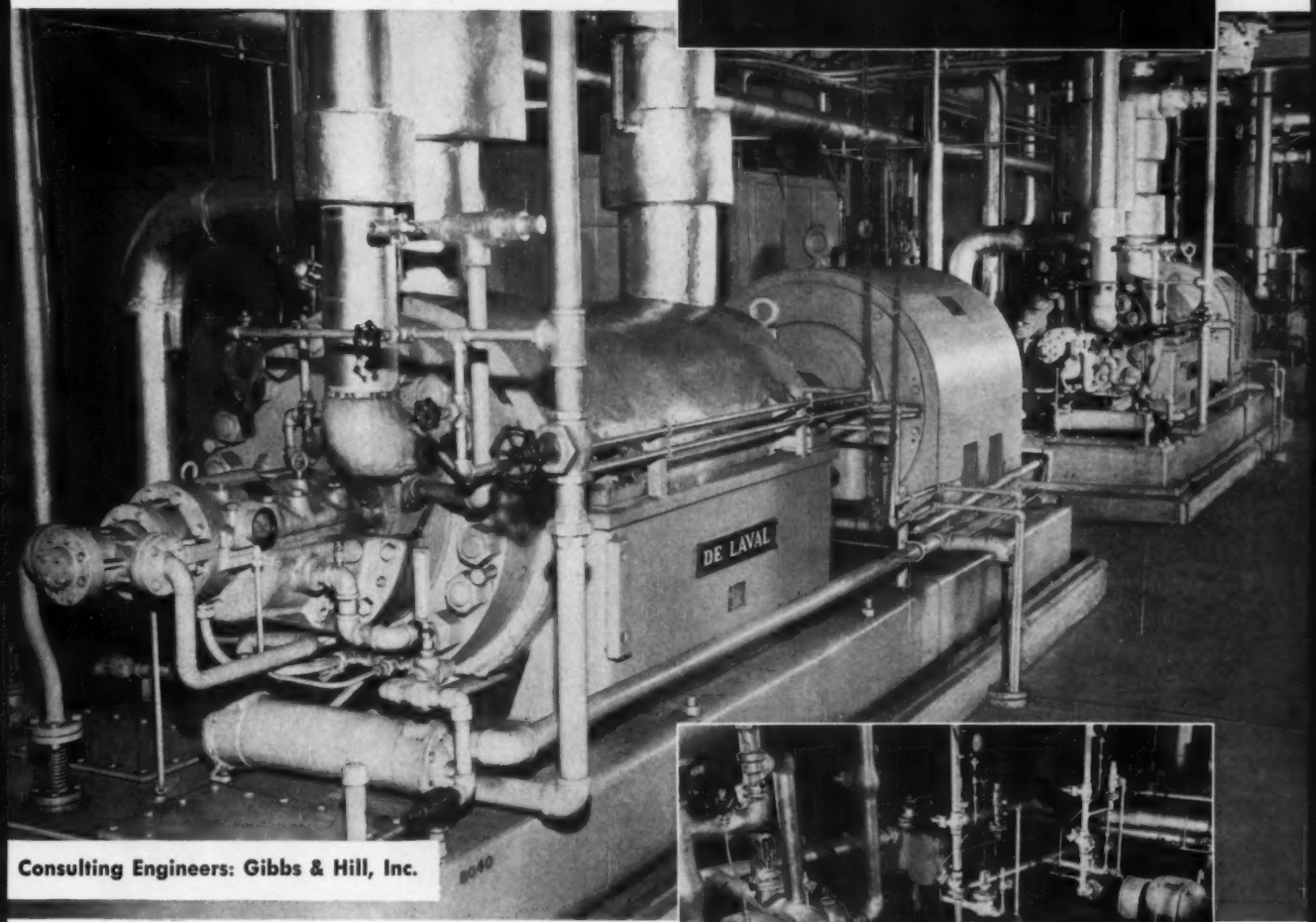
LIVE BETTER ELECTRICALLY

looks at Tomorrow, Today!

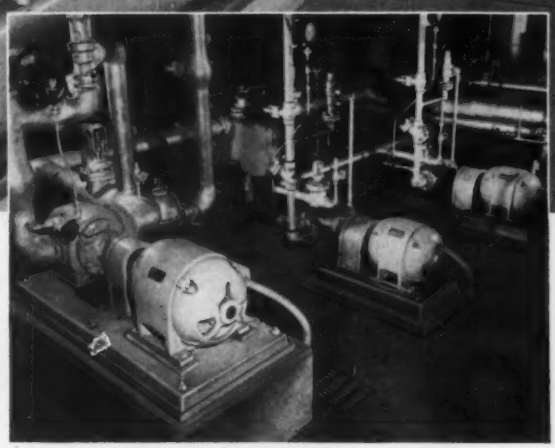
HOTPOINT CO. *(A Division of General Electric Company)* ***5600 Taylor Street, Chicago 44, Illinois***

Atlantic City Electric ... another utility using

DE LAVAL
BARREL TYPE BOILER FEED PUMPS



Consulting Engineers: Gibbs & Hill, Inc.



De Laval IMO rotary positive displacement pumps handle heavy fuel oil. They are used for standby operation.

Atlantic City Electric Co. and Gibbs & Hill, Inc., Consulting Engineers, know that they can count on De Laval reliability. That's why they selected three De Laval high pressure barrel type boiler feed pumps for the Deepwater Station in Penns Grove, New Jersey. These 10-stage units deliver 675 gpm, operating at 1762 psi with temperature at 287 F. The pumps are driven by 900 hp motors.

De Laval barrel type boiler feed pumps operate at pressures up to 5500 psi. These units offer many important design advantages, such as double volute diaphragm, individual diaphragm bolting, only one inner high-pressure joint, and bare shaft construction. Their dependability is proven by year in, year out service in public utilities and industrial plants.

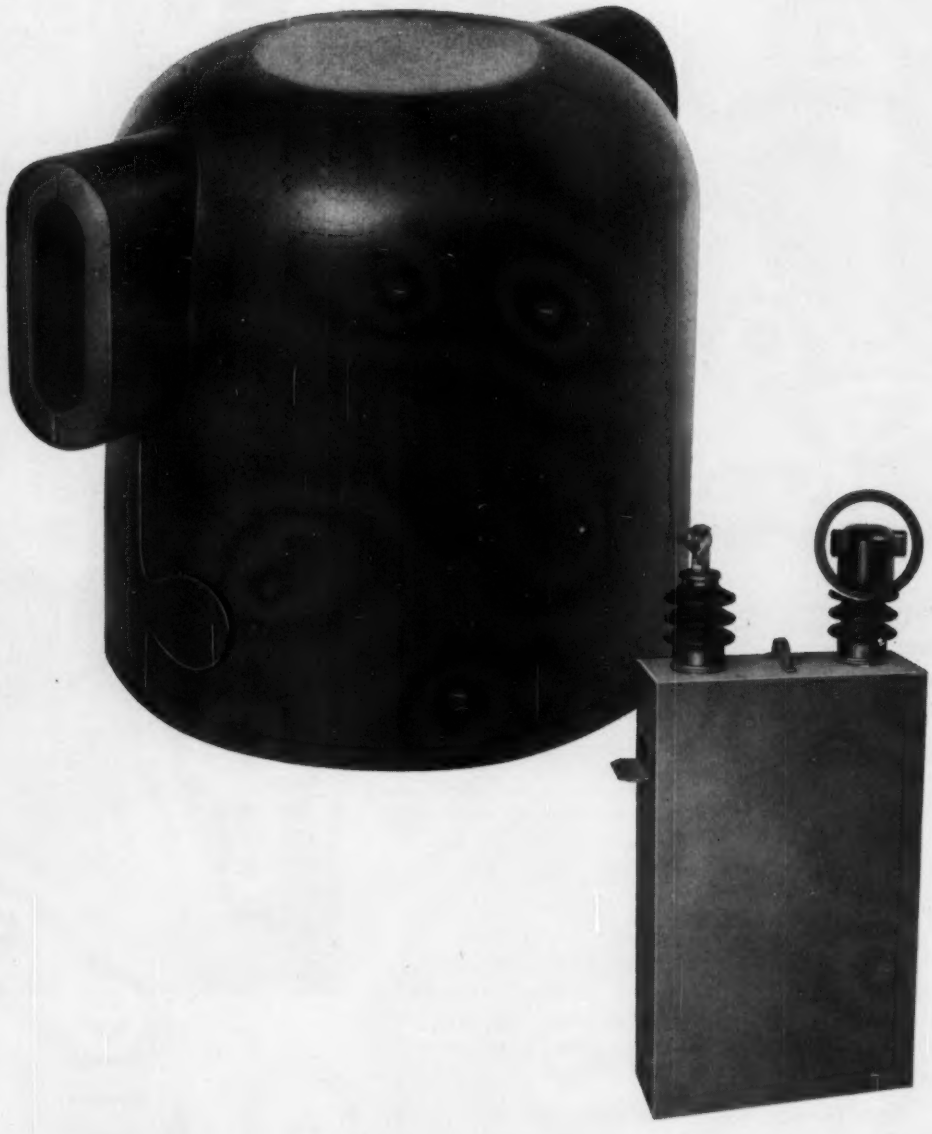
Send for De Laval Bulletin 1506, which contains helpful data.

DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY
861 Nottingham Way, Trenton 2, New Jersey

L-343

Capacitor prog



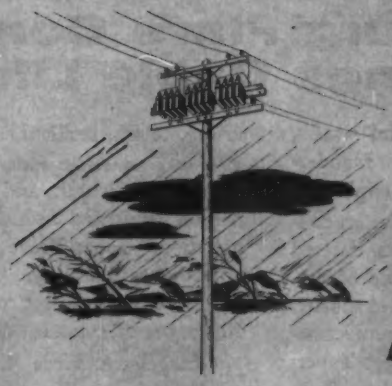
WATERTIGHT!

ress starts with TOBE

TOBE ENGINEERS KNOW that progress means not only monumental changes, but small improvements that can make a big difference in the daily operation of a utility. For example: look at the self-locking rubber insulator cap on the left! Small—but did you ever try to tape a connector while hanging from a safety belt? It's time-consuming and none too safe to say the least. But with this TOBE insulator*, slap it over the connector, pull it together: presto you have a safe, enduring shield, (exceedingly simple to take apart).

TOBE TEMPALL CAPACITORS *also feature:*

- Special clamp arrangement with vibration-proof nylon-insert stop-nut on line hardware;
- Stainless steel case, at no extra cost;
- Losses consistently lower than requirements;
- Factory engineering field supervision;
- Individual control of every capacitor during assembly and impregnation;
- Discharge resistors across each series group;
- Because of low losses resulting from TOBE's design and manufacturing technique you get more correction for your dollar.



That's why it pays to investigate TOBE capacitors today. Available in all standard ratings: in single units, racks, pole assemblies and complete cabinets. Write to Tobe Deutschmann Corporation, Norwood, Mass., or phone Norwood 7-2620, collect for further information today.

LOOK TO TOBE FOR PROGRESS

TOBE

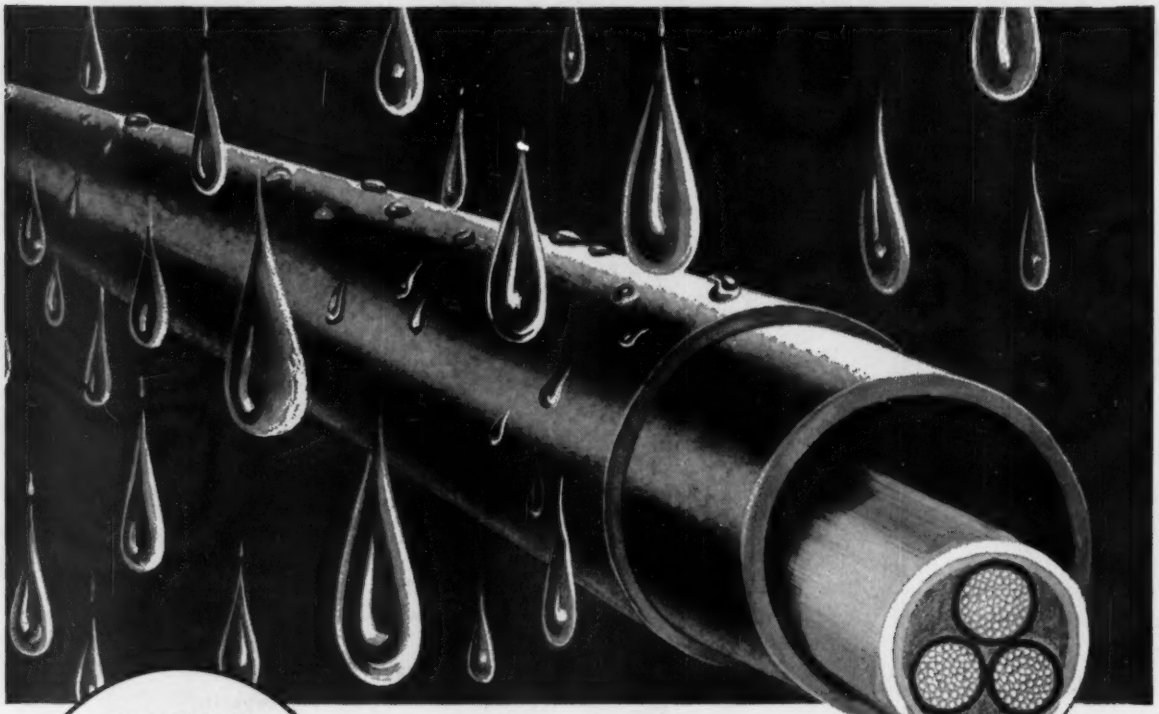
TEMPALL CAPACITORS

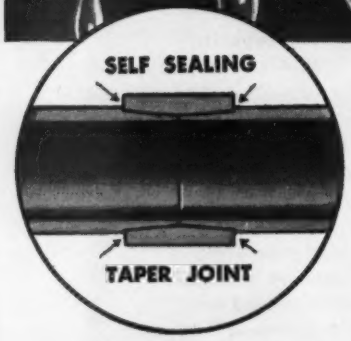
*PATENT PENDING

Since 1929 persistent research, trustworthy engineering, rigid production standards.

Laboratory Checking of
KEARNEY FUSE LINKS

WATERTIGHT!





Orangeburg Fibre Conduit Prolongs Cable Life

Keep out corrosive ground waters, and you prolong the life of underground cables, say utility engineers!

Why? Because ground waters containing corrosive elements derived from the soil and concrete encasement attack cable sheath and shorten cable life. Orangeburg's impermeable wall and self-sealing Taper-Sleeve Joint shed them *"like water off a duck's back."* You get maximum protection with Orangeburg.

Orangeburg protects cables in many other ways. Smooth bore, low co-efficient of friction reduce incidence of abrasion. Its material is strong, tough, resilient, durable.

No other conduit is easier to install

Light, 8-foot lengths and a complete line of bends and fittings speed installation. Taper-Sleeve Joints tap water-tight in a jiffy. Orangeburg lays faster and at lower cost than any other type of conduit.

Orangeburg Fibre Conduit has prolonged cable life at minimum expense for utilities, municipalities and industry since 1893.

Distributed by Graybar Electric Company and by General Electric Supply Company. Branches and stocks in principal cities.

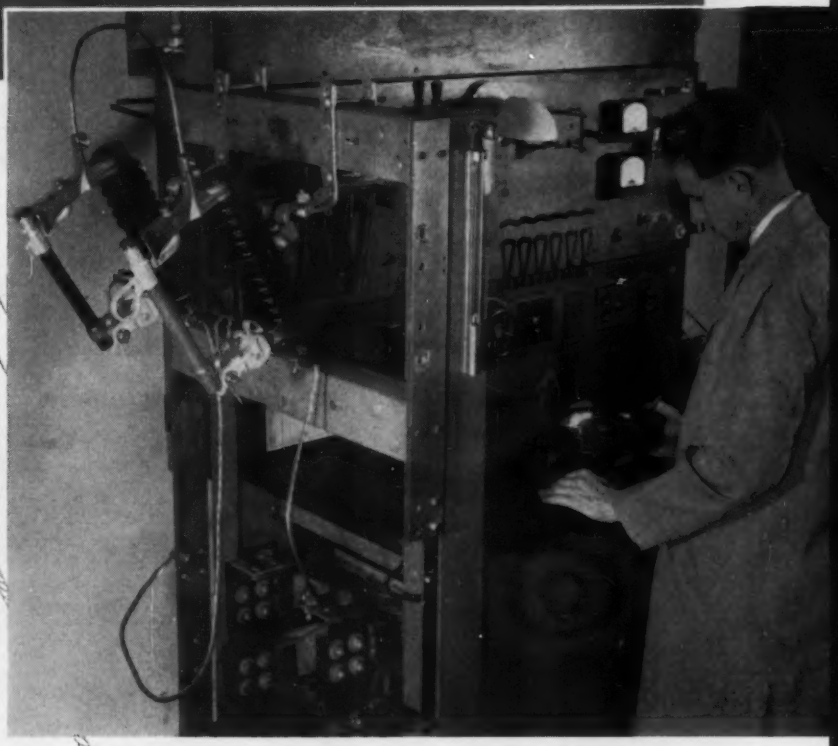
WRITE DEPT. EW-27 FOR CAT. 52

ORANGEBURG MANUFACTURING CO., INC., Orangeburg, N. Y. West Coast Plant, Newark, Calif.

ORANGEBURG®
FIBRE CONDUIT

KEARNEY FUSE LINKS

Your Assurance of Dependable PROTECTION



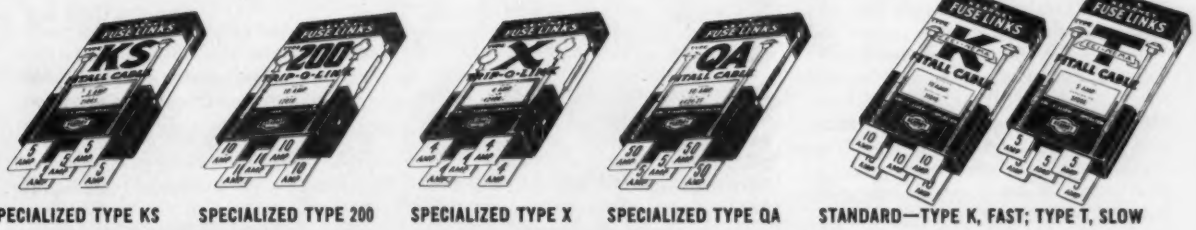
Today's improved techniques in power transmission and distribution provide better service for more users . . . but impose correspondingly greater demands on protective apparatus. KEARNEY, the always-reliable name in primary fuse link engineering, has kept pace with these needs, developing Fuse Links which safely satisfy modern operating requirements.

The vital *plus* in KEARNEY Fuse Links is *accuracy* of performance, proved by extensive, continuous tests *duplicating field conditions*, at the KEARNEY Substation Laboratory.

Standardize on KEARNEY Fuse Links. They're design-matched with modern safe loading curves . . . for positive equipment protection . . . for close coordination from service drop to substation.

KEARNEY Specialized and Standard Fuse Links . . .
for accuracy, reliability

FAST SERVICE! Routine or emergency shipments from KEARNEY field warehouse near you will supply your needs in a matter of hours



SPECIALIZED TYPE KS | SPECIALIZED TYPE 200 | SPECIALIZED TYPE X | SPECIALIZED TYPE QA | STANDARD—TYPE K, FAST; TYPE T, SLOW

JAMES R. KEARNEY CORPORATION, *General Offices:* 4224-42 Clayton Avenue, St. Louis 10, Missouri -346

for BETTER CONSTRUCTION
SAFER MAINTENANCE
Specify

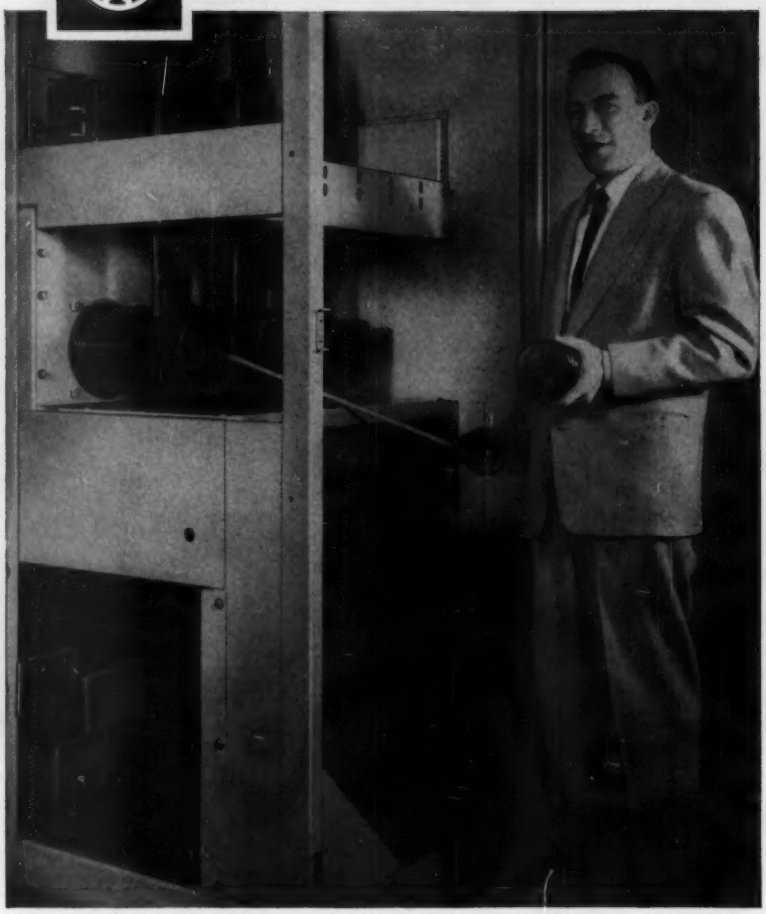
JAMES R. KEARNEY CORPORATION ST. LOUIS, MO. GUELPH, ONT.

The Mark of Quality

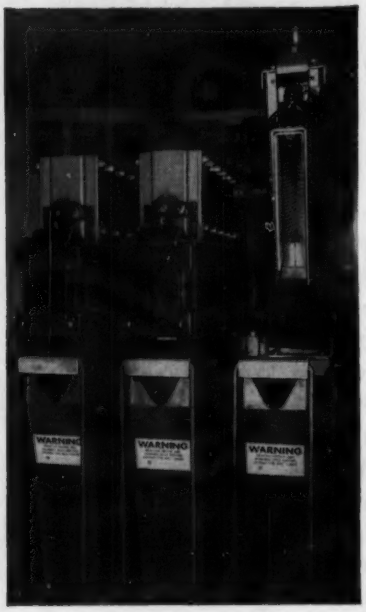
KEARNEY PRODUCTS

Plants at: ST. LOUIS • FAYETTEVILLE, ARK. • SHENANDOAH & CLARINDA, IOWA—GUELPH, ONT., CANADA

METAL-CLAD SWITCHGEAR



PURIFIED PORCELAIN in horizontal and vertical bus supports, primary disconnect bushings and caps and epoxy in bus joint covers provide excellent insulation, prevent fires in 15 kv I-T-E metal-clad switchgear.



EPOXY AND SPECIAL CERAMICS protect personnel and equipment by preventing fires in the circuit breaker section. Arc chute rear supports and blowout coils are epoxy. Jump gap cooling plates, arc chute liner plates, arc plates and spacers are special ceramics.

Only the finest fire-protective insulating materials

Nonflammable porcelain and ceramics, flame-resistant epoxy, and other flame-retardant insulating materials throughout, are among the extra values you find in I-T-E Metal-Clad Switchgear. Purified porcelain, of which the primary disconnect bushings and caps are made, also supports both vertical and horizontal bus. It is nonflammable, has high dielectric strength, won't track or deteriorate, is inherently contamination free.

Epoxy, which can be molded into complicated shapes, forms arc chute rear supports, blowout coils, bus joint covers, potential and current transformers. It has high mechanical and dielectric strength, is nontracking and extremely flame resistant.

Special ceramics, highly resistant to direct arc exposure, are used in jump gap cooling plates, arc chute liner plates, arc plates and spacers. These have high dielectric strength, low moisture absorption, won't track, are excellent interrupting materials. They do not deteriorate when subjected to direct arc exposure. They absorb thermal shock and deionize gases without excessive heating.

Phenolic and polyester insulating sheets and moldings, specially treated to provide the highest possible degree of flame-retardant characteristics, are also used.

If you are planning new construction or modernization requiring electric power, consider the advantages of I-T-E equipment. Consult your local I-T-E sales office or write I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY • Switchgear Division

IN CANADA: EASTERN POWER DEVICES, LTD.

POWERS *American* PRESENTS . . .

an aerial unit designed specifically for operations requiring only one workman

THE COMPLETELY NEW

Series AB-1-41

"Sky-Master"

HYDRAULIC AERIAL BEAM

FOR WORKING IN HARD-TO-REACH PLACES WITH GROUND-LEVEL EASE

Over • under • around obstacles . . . Sky-Master quickly reaches out-of-the-way work — and provides on-the-ground safety and comfort for the workman.

Independently-operated steel beams are moved by double-acting hydraulic cylinders, through a unique system of linkage which greatly increases operating range. There are no chains, sprockets, or other secondary means of actuation. Supporting mast can be rotated *continuously* in either direction.

Work basket and insulated outer beam protects workman from 60,000 volts. Basket is automatically locked in position in event of damage to hydraulic lines.

The AB-1-41 . . . having ground-to-basket floor height of 41' . . . can be equipped for your particular job, and installed on a Powers-American Body that fits your needs.

The heavy-duty Series AB-37 and AB-43 Sky-Master carries two men up, out, over, or down. Available in 37' and 43' ground-to-basket heights.

Descriptive literature on Series AB-1 and Series AB Sky-Master — with price information — will be sent on request.

McCABE-POWERS AUTO BODY COMPANY

5900 NO. BROADWAY • ST. LOUIS 15, MO. • 625 CEDAR ST. • BERKELEY 10, CALIF.

Appalachian Electric Power Sparks 21% Increase in Appliance Sales During 1956

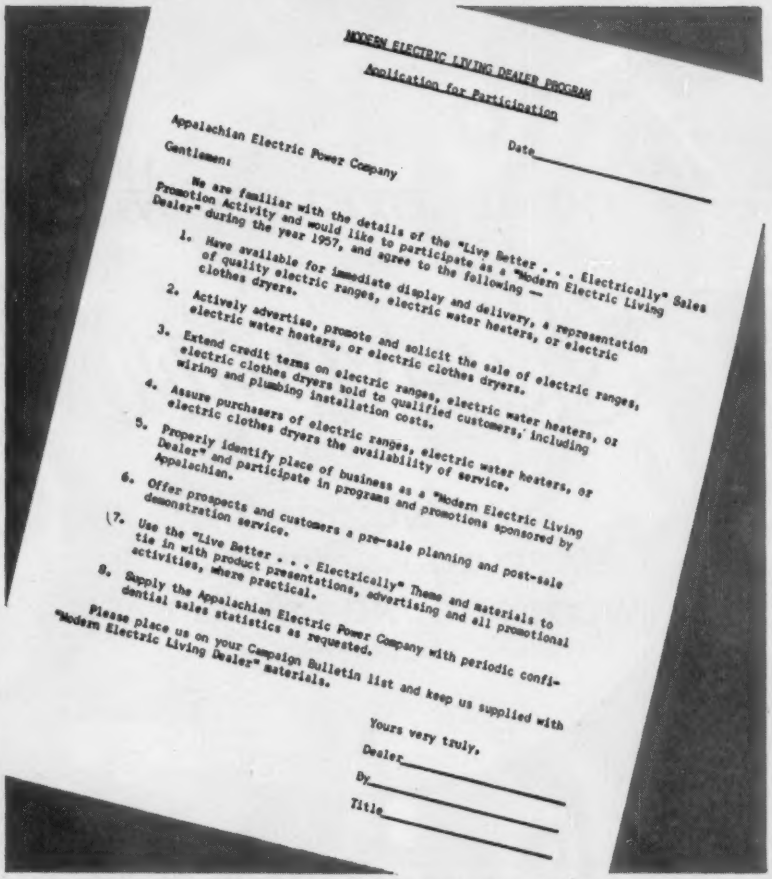
"Live Better Electrically" theme of '57 sales drive

Last spring, 1,250 appliance dealers in Virginia and West Virginia teamed up with Appalachian Electric Power Co. in a full-scale campaign to sell electric ranges, dryers and water heaters. They took full advantage of advertising and promotional materials made available by "Live Better Electrically," and, at year's end, sales totaled 57,950 new units — an increase of 21% over the previous year.

Buoyed by this sales jump, this team — utility, dealers and distributors — is looking forward to greater results from an even bigger campaign in 1957 — under the "Live Better Electrically" banner. Their sales goal is 60,000 units — and they expect to make it!

Appalachian weaves the "Live Better Electrically" materials into its own continuing promotion. They make profitable use of the powerful selling tools that "Live Better Electrically" provides for local tie-in with the national consumer campaign, and they include HOUSEPOWER as an important element of their well-rounded program. As a dealer incentive, the utility stimulates outstanding sales achievement with cash awards, premiums and trips to dealer salesmen.

This dramatic example of how a utility and its trade allies can profit mutually by creative local use of the industry-wide "Live Better Electrically" program is typical of the many successful campaigns sponsored by electric utilities throughout the country.



MODERN ELECTRIC LIVING DEALER PROGRAM

Application for Participation

Date_____

Appalachian Electric Power Company

Gentlemen:

We are familiar with the details of the "Live Better . . . Electrically" Sales Promotion Activity and would like to participate as a "Modern Electric Living Dealer" during the year 1957, and agree to the following —

1. Have available for immediate display and delivery, a representation of quality electric ranges, electric water heaters, or electric clothes dryers.
2. Actively advertise, promote and solicit the sale of electric ranges, electric water heaters, or electric clothes dryers.
3. Extend credit terms on electric ranges, electric water heaters, or electric clothes dryers sold to qualified customers, including wiring and plumbing installation costs.
4. Assure purchasers of electric ranges, electric water heaters, or electric clothes dryers the availability of service.
5. Properly identify place of business as a "Modern Electric Living Dealer" and participate in programs and promotions sponsored by Appalachian.
6. Offer prospects and customers a pre-sale planning and post-sale demonstration service.
7. Use the "Live Better . . . Electrically" Theme and materials to tie in with product presentations, advertising and all promotional activities, where practical.
8. Supply the Appalachian Electric Power Company with periodic confidential sales statistics as requested.

Please place us on your Campaign Bulletin list and keep us supplied with "Modern Electric Living Dealer" materials.

Yours very truly,

Dealer_____

By_____

Title_____

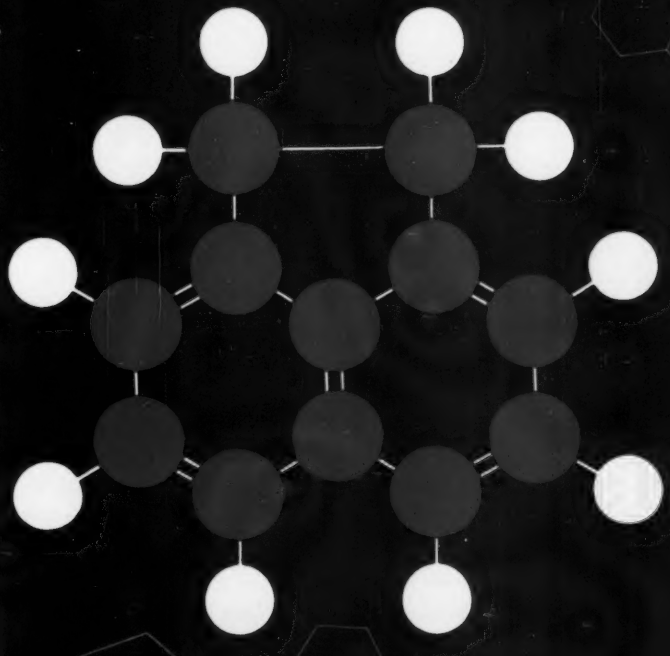
Dealers pledge active support of Appalachian's "Live Better Electrically" campaign by signing this application form. "Live Better Electrically" sales-promotion and advertising materials will be used in a continuing campaign to boost sales of electric appliances.

Appalachian's dealer kit for 1957 features powerful local selling tools provided by "Live Better Electrically." Included are materials for newspaper ads, publicity, handouts, displays, die-cut emblems, mailing pieces, posters, banners, streamers, counter cards, slogans and hang tags.

LIVE BETTER
...Electrically

LIVE BETTER ELECTRICALLY

A united effort by everyone in the electrical industry — utilities, manufacturers, dealers and distributors, builders, contractors — to increase residential load and sales of electrical merchandise.

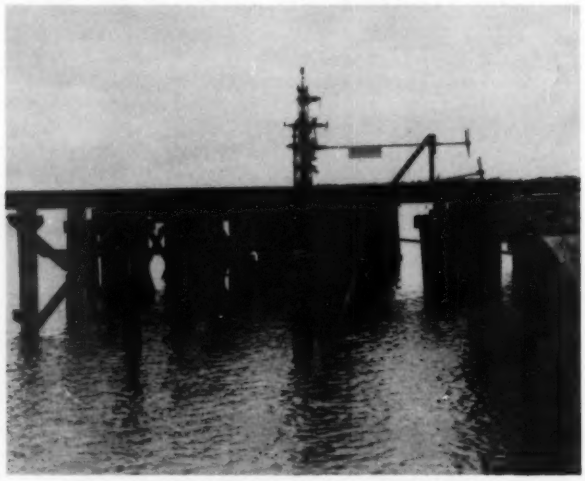


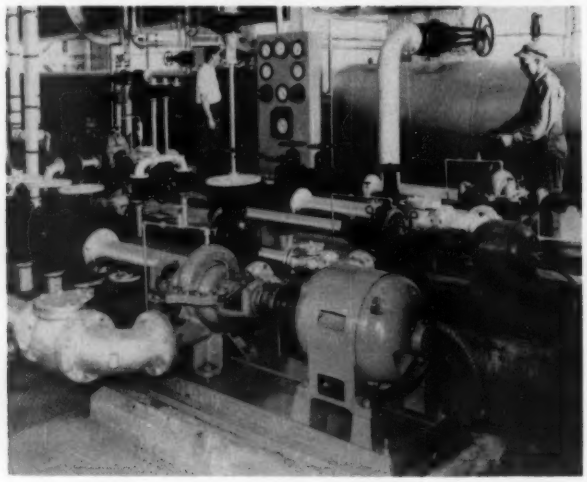
Let's take a fresh look at

CREOSOTE...

a galaxy of molecules makes it
your best wood preservative investment!

Here are some vital facts you





Laboratory and field tests show why CREOSOTE gives the most protection for your preservative dollar

Laboratory Research is a never-ending process with creosote producers. Koppers researchers are constantly exploring the composition of creosote—some of its 162 chemical constituents are shown on our cover—for more information on its uniquely effective preservative action. Research such as this has already demonstrated that more than 50 of creosote's compounds are toxic to insects and fungi. This multiple toxicity is one of the reasons you can get *50-year plus* preservation from creosote.

Field Research has proved that creosote has the greatest "staying power" of any wood preservative, even under severe leaching conditions that soon render other chemicals ineffective. Tests have been conducted at a well-known marine testing facility to ascertain just what the leaching effect of sea water does to various preservatives. Creosote has shown itself to have the longest toxic life under these severe conditions. This field testing has also led to formulations of creosote that have improved its resistance to limnoria in marine service.

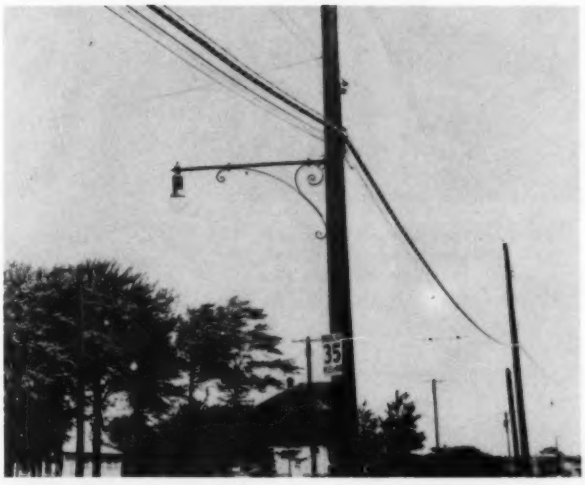
You, The Customer benefit from this research work since up-to-date knowledge of creosote and effective treating procedures is made available to the entire industry through the American Wood Preservers Institute. As a result of this cooperation, industry-wide specifications assure clean, uniform treatment that gives the user of pressure-creosoted wood full value for his preservative investment. A typical control room of a modern treating plant is shown at left.

CREOSOTE...
the modern preservative

should know about CREOSOTE!

Every day brings new proof that CREOSOTE gives pressure-treated wood unequaled service life

Construction Firms know, from experience, that creosote is the only wood preservative safe for use where long life of wood construction materials is the prime requisite. The piling shown, for example, was pressure-creosoted in 1897 and has been in service for 59 years without any sign of decay or structural failure. Leading consulting engineers endorse pressure-creosoted foundation piling as a construction material with an expected life of at least 100 years.



Utilities realize too, that creosote is the only preservative proved by the test of time. The poles shown have given more than 56 years service in an electrical utility's line . . . and there's no sign of replacement needed. All over the country, utilities depend on pressure-creosoted poles for long-lasting, economical distribution and transmission systems. There's nothing that can compare with creosote for clean, effective protection of utility poles: some half-million poles have been delivered to the largest utility network in the country, *and there hasn't been a single complaint about cleanliness.*

Railroads are solidly sold on creosote as the best wood preservative. Tie life depends on creosote! Through almost universal adoption of pressure-creosoting, the nation's railroads have increased the average life of their crossties from 6 years for untreated ties to more than 35 years for pressure-creosoted ties. In fact, the principal cause of tie failure today is *not* decay, but the effects of traffic and other factors which cause mechanical failure.

Wherever wood is used as a permanent construction material, experience shows your best investment in a preservative is CREOSOTE!

with a proved record.

UNIQUE CASE HISTORY

of extended utility pole life proves the unequaled preservative action of CREOSOTE!

Pressure-creosoted poles have been used in England since 1870. Many poles still in service are more than 80 years old.

In a quaint English village, Koppers Tar Products Division personnel found telegraph poles which had been installed so long ago that accurate records of their age were not available. However a search of the files of Her Majesty's Post Office, which has charge of telegraph and telephone communications, indicated that many of the poles in this same line had been in service since 1875!

A pole which bore legible markings of 1893 was removed from service for inspection. As shown in the photo below, there was no trace of decay or deterioration—even in the 8-foot portion of the pole which had been underground for more than 63 years!

It's through case histories such as this that creosote has established its recognition for proved preservative action. It's as true today as it was well over 50 years ago—*when long life of wood is required, there's no substitute for creosote.*

An official of Her Majesty's Post Office (left) and Mr. R. R. Holmes, Koppers Tar Products Division Vice President, examine good condition of buried portion of ancient pole.

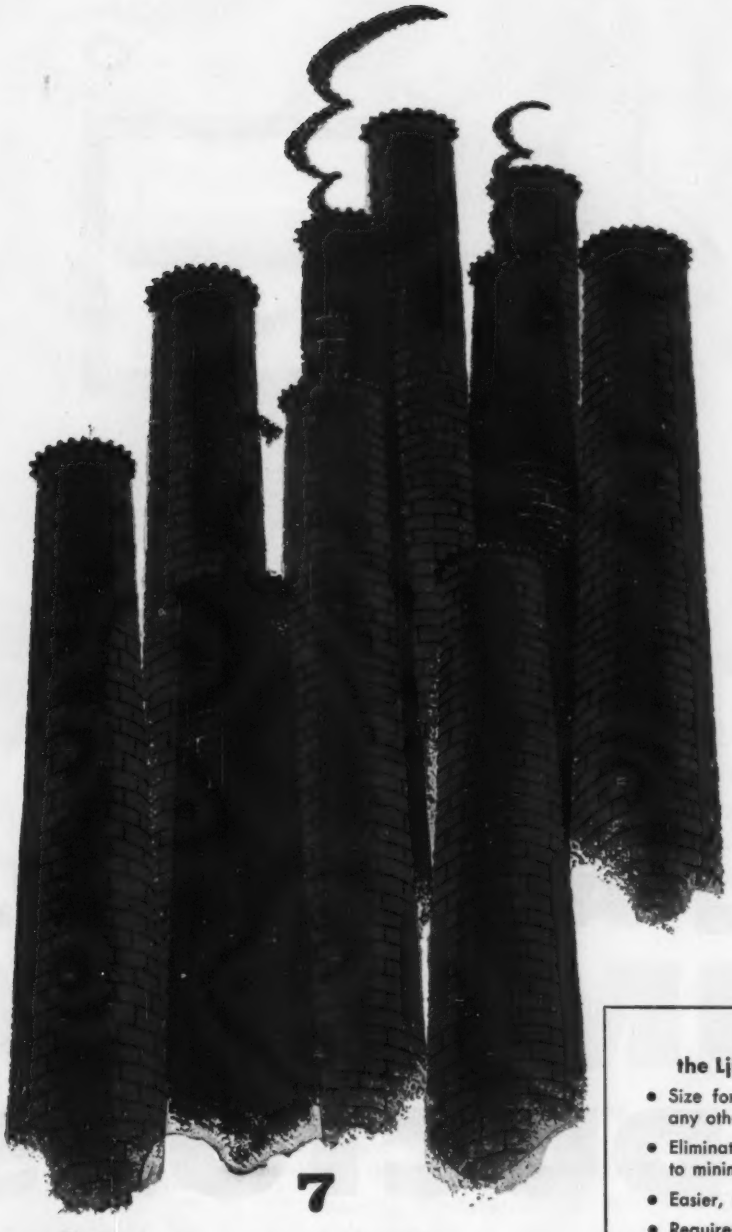
Get all the facts on CREOSOTE

before you decide on any preservative treatment

Write today for your copy of this booklet telling "Why 90% of Wood Preserved Today is Preserved with Creosote." You'll find it full of facts and figures which prove that among all preservatives, your best investment is creosote . . . for long life and real economy. Address your request to Koppers Company, Inc., Tar Products Division, Dept. 1450, Pittsburgh 19, Pa., or to the Koppers District Office near you.

KOPPERS

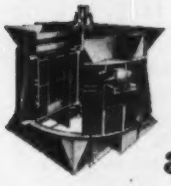
CREOSOTE
TAR PRODUCTS DIVISION



Advantages of the Ljungstrom Air Preheater

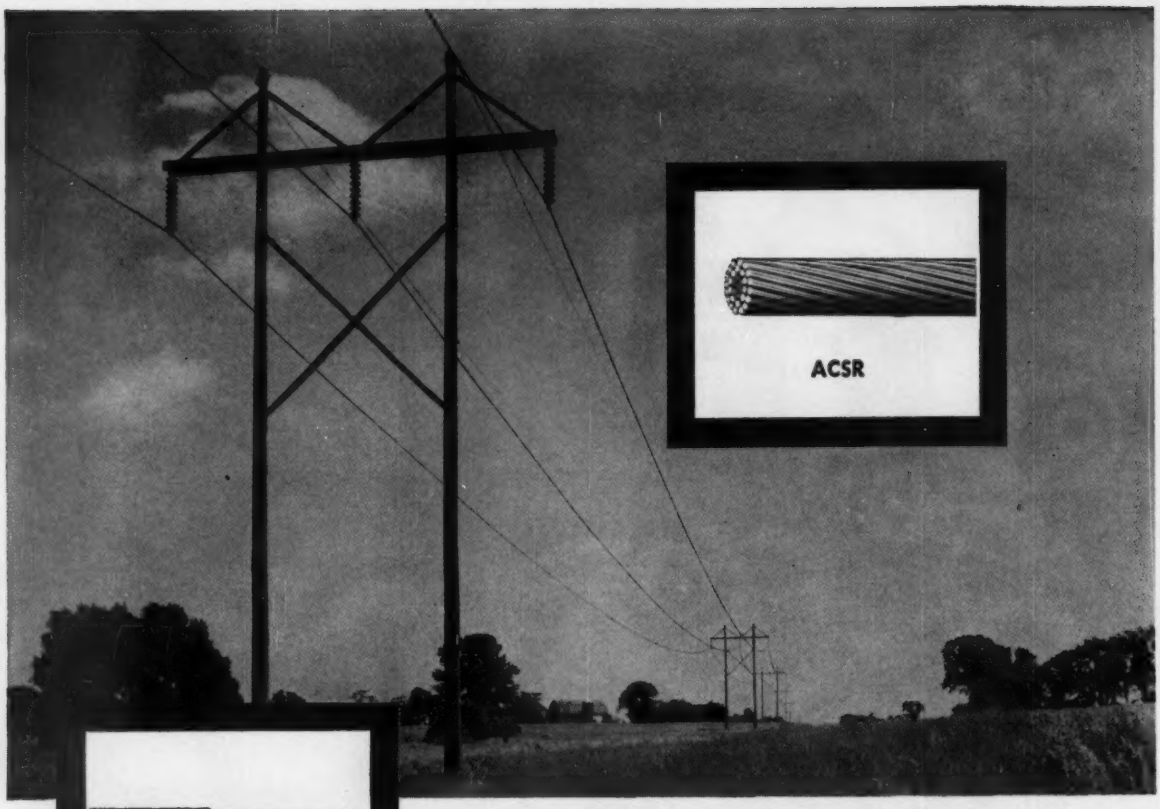
- Size for size, recovers more heat than any other type.
- Eliminates cold spots . . . keeps corrosion to minimum.
- Easier, faster to clean and maintain.
- Requires far less supporting steel and is quickly erected.

7 out of 10. . . air preheater installations are Ljungstrom®



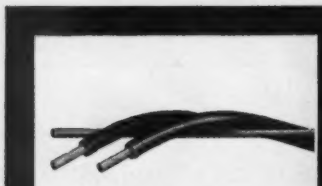
MAXIMUM HEAT RECOVERY is one important reason. As a general rule, a height of one inch of the heating surface used in a Ljungstrom Air Preheater will recover about as much heat as one foot of length of the standard surface of conventional type air preheaters. For the interesting full story, send for a free copy of our 38-page manual.

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.



GENERAL CABLE

ALECTRAL ALUMINUM CONDUCTORS



Consistent, outstanding performance mark General Cable's ALECTRAL Bare and Insulated aluminum conductors. Manufactured to General Cable's high standards in all sizes. Bare ACSR and aluminum • Weatherproof aluminum and ACSR conductors • All types of service drop cables. ALECTRAL is available with a complete range of paper, rubber and thermoplastic insulations, backed up by over 75 years of General Cable's engineering and manufacturing experience.

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420 Lexington Avenue, New York 17, N. Y.
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Here's your quick and ready reference to Thomas EEI-NEMA Standards.
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The complete line of THOMAS EEI-NEMA PORCELAIN INSULATOR STANDARDS is illustrated and identified both by EEI-NEMA Class Numbers and by THOMAS Catalog Numbers.

This new eight-page bulletin is the kind of ready reference you'll want at your fingertips — for convenience in selecting and ordering standard SUSPENSION, PIN-TYPE, APPARATUS, GUY-STRAIN or SPOOL Insulators for all applications.

THE R. THOMAS & SONS CO.
Lisbon, Ohio

Gentlemen: Please send my copy of the new THOMAS EEI-NEMA Standards Bulletin.

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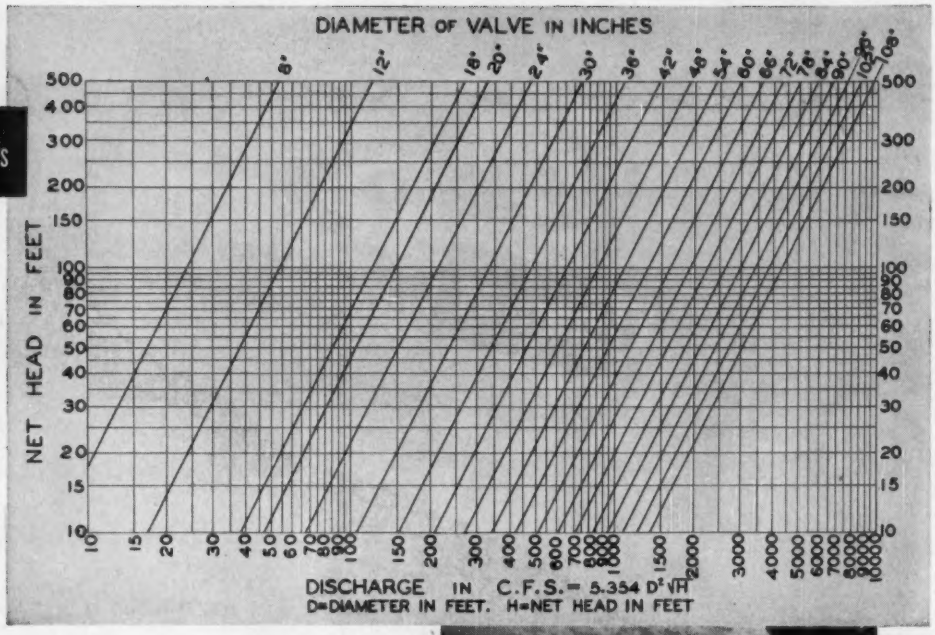
SMS
HOWELL-BUNGER VALVES



EASY REGULATION OF FREE DISCHARGE THROUGH HIGH TO LOW HEAD RANGE

SMS Howell-Bunger Valves provide easy regulation and control of water under free discharge. Tremendous amounts of energy can be dissipated with a minimum of erosion, cavitation and no vibration. Because of this valve's high discharge coefficient, pipe line or conduit size can be held to a minimum for economical construction.

The extremely rugged and simple design of the SMS Howell-Bunger Valve provides these essential features:

- Free discharge with safe energy dissipation
- Hydraulic balance without vibration
- High coefficient of discharge for an energy dissipating valve
- Minimum cavitation and maintenance
- Simplicity of operation
- Only one moving part in contact with stream flow
- Low initial cost
- Discharges into atmosphere or submerged.

S. Morgan Smith Company offers you more than 75 years experience with hydraulic equipment. The SMS name plate is your assurance that performance will equal or exceed specifications. For full information on Howell-Bunger Valves, turbines and related hydraulic equipment write the S. Morgan Smith Company, York, Pennsylvania.

Hydraulic Turbines
Pumps
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Accessories

HYDRODYNAMICS

Rotovalves
Ball Valves
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Free-Discharge Valves
Controllable-Pitch Ship Propellers

S. MORGAN SMITH CO.

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

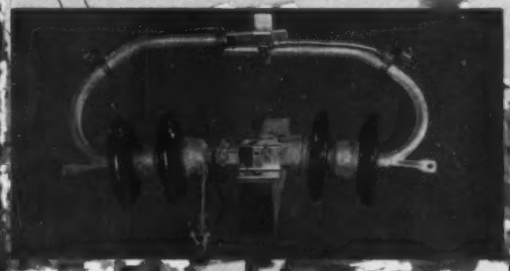
KPF switches operate smoothly, surely in all weather!

What's *your* weather? Arctic cold? Tropical rain? Parching desert sun? KPF switches operate unfailingly under all conditions. Their exclusive mechanical design permits a slight amount of movement before opening the switch so even extreme ice formations can be cracked off easily. Warpage cannot jam the switch, and lack of lubrication is never a problem.

KPF phase units consist of two rigid dead-end assemblies with rigid jumpers forming the switch arms. One is stationary, the other rotates to make or break the circuit. There's no delicate, complex mechanism to malfunction.

Their utmost design simplicity means KPF switches weigh less, install faster without extra bracing, need no servicing, cost less. They have proved themselves in almost 50 years of major system operation, on lines carrying 7.5 to 110 KV and amperages from 200 to 600 amperes.

Get the details, then order a test installation and see for yourself!



For catalog, complete specifications, write direct

KPF
AIR BREAK SWITCHES
Standard for nearly half a century

3615

KPF ELECTRIC COMPANY
1624 E. Alpine Avenue
Stockton 5, California
Dept. E

NOW

Southwire Vinyl

"IT'S TOUGH"

weather-resistant

▸ LINE WIRE

▸ SERVICE DROPS

TRIPLEX — DUPLEX — QUADRUPLEX

To meet the need for a high quality weather-resistant material for line wire and service drops, Southwire proudly presents a new covering—*Southwire Vinyl*—that is competitively priced!

It combines remarkable toughness and resistance to weathering. At the same time it provides a conductor jacket that results in a light, small diameter wire.

Southwire Vinyl has these outstanding qualities:

- **High abrasion and tear resistance**
- **Light, easy to handle; good flexing properties**
- **Free stripping**
- **Excellent resistance to sun; low moisture absorption**
- **High tensile strength and elongation**
- **Wide installation and operation temperature ranges**
- **Resistant to acids, alkalies, oils and greases**
- **Flame resistant; will not support combustion**

Try this new Southwire product with the full assurance that it will meet the severest of tests or applications.

SOUTHWIRE PRODUCTS

- Bare and Weatherproof Copper and Aluminum Line Wire
- Neoprene Weatherproof Copper, Aluminum and Triplex
- Polyethylene Weatherproof Copper, Aluminum and Triplex
- Southwire Vinyl Weatherproof Copper, Aluminum and Triplex
- Copperweld® Conductors
- Copper and Aluminum Building Wire
- ACSR and All Aluminum Cable
- Steel Guy Strand and Static Wire
- Aluminum Alloy Wire
- Cable Accessories

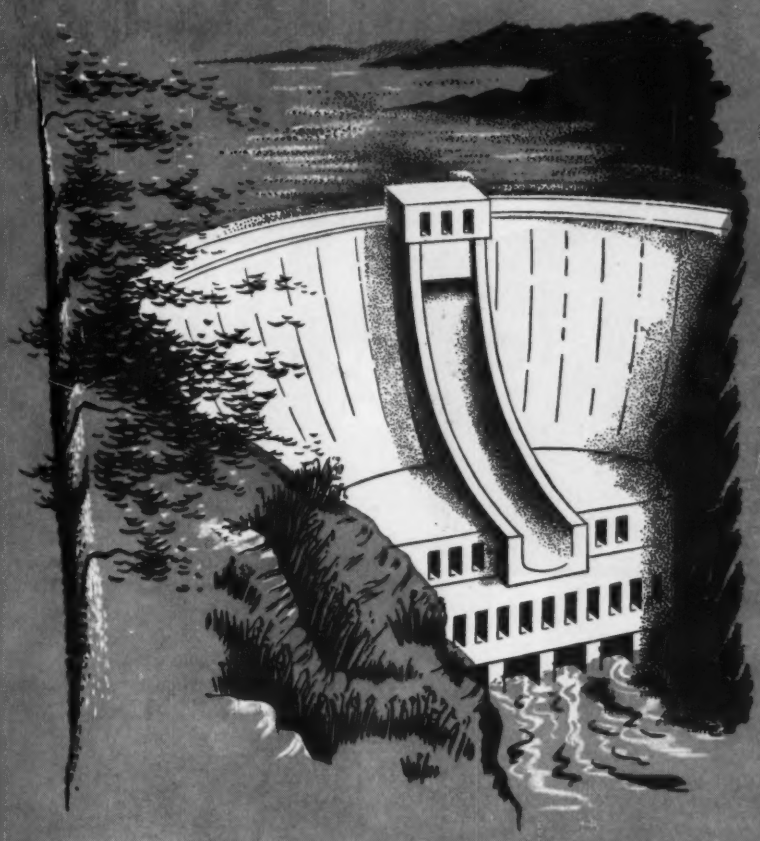
Southwire means service

Southwire Company

SOUTHWIRE

TErrace 2-6311 CARROLLTON, GEORGIA

How I-R condenser design



FERRANTI

Transformers for Hydro-Electric Schemes

As specialists in the manufacture of transformers for more than 65 years, FERRANTI LTD. have been associated with many of the world's largest hydro-electric schemes.

More recent achievements include contracts for over 4,000,000 kVA of large high voltage power transformers, among which are :-

CENTRAL AFRICA

Two 120,000 kVA and six 60,000 kVA 330,000 volts three-phase Transformers have been ordered by the Central African Federation Power Board for the Kariba Hydro-Electric Scheme. This is the largest overseas transformer contract ever to be placed in the United Kingdom.

CANADA

Seven 71,000 kVA, 301,400 volt single-phase Ferranti generator transformers and six 37,000 kVA, 275,000 volt step-down Ferranti transformers have been ordered by the Aluminum Company of Canada Ltd. for the Alcan Project at Kemano and Kitimat, British Columbia. Four of the generator transformers and all of the supply transformers are now in commission.

U.S.A.

GARRISON DAM PROJECT Nine 33,333 kVA, 230,000 volt single-phase Ferranti transformers forming three 100,000 kVA banks have been supplied to the U.S. Army Corps of Engineers for the Garrison Dam Project, North Dakota.

McNARY DAM PROJECT Six 56,000 kVA, 230,000 volt, single-phase transformers have been ordered by the U.S. Army Corps of Engineers for the McNary Dam Project, Oregon.

DALLES DAM PROJECT The contract covers eighteen 63,000 kVA, 230 kV and three 63,000 kVA, 115 kV, single-phase transformers for the U.S. Army Corps of Engineers Dalles Dam Project, Columbia River.

NEW ZEALAND

Twenty-six Ferranti large power transformers have been ordered by the State Hydro-Electric Department of New Zealand. Thirteen 14,800 kVA, single-phase, 50 cycles, 11/220 kV transformers have already been supplied to Roxburgh. Thirteen 9,259 kVA. single-phase, 50 cycles, 11/220 kV transformers for Whakamaru are under construction.

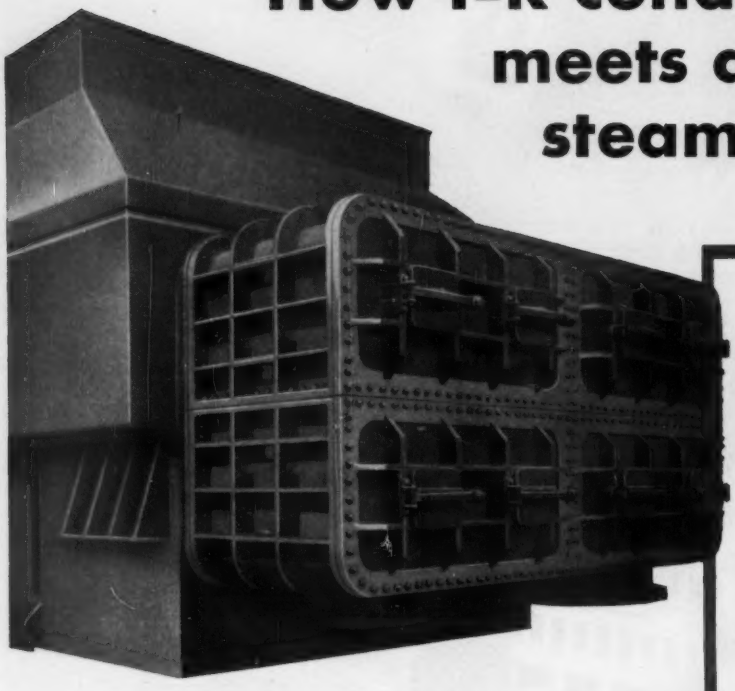
INDIA

Three Ferranti 20,000 kVA, OFB, 3-phase, 50 cycles, 132/33-66 kV transformers with on-load tap changing gear and two Ferranti 10,000 kVA, ON/OB, 3-phase, 50 cycles, 132/33 kV transformers with on-load tap changing gear have been supplied for the Damodar Valley Power Scheme in India.

FERRANTI LTD · HOLLINWOOD · LANCS

London Office: KERN HOUSE, 36 KINGSWAY, W.C.2.

How I-R condenser design meets all of today's steam plant needs

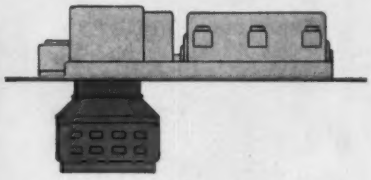


...Sets the pace in turbine-condenser adaptability

Permitting variations in condenser length, width and height without sacrificing performance, the Ingersoll-Rand rectangular design proves readily adaptable to all steam plant needs. Dimensional proportions can be changed over wide limits without departing from the basic standard arrangement of internal elements. This means maximum utilization of the condenser space available.

Continued refinements in I-R design are contributing to ever smaller space requirements for a given condensing capacity. These developments conform with the modern trend to higher turbine efficiencies and more compact turbine designs in reduced foundation areas for a specified kw rating.

Your I-R engineer will be glad to give you further information and submit recommendations to meet your particular requirements.

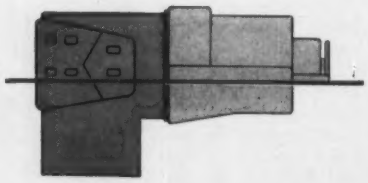


BOTTOM-EXHAUST TURBINE

Serving a 135,000-kw turbine, this condenser having 65,000 sq. ft. surface requires a headroom of only 14 feet 8 inches. It assures maximum economy of installation, operation and maintenance.

SIDE-EXHAUST TURBINE

Mounted on the turbine floor, the twin condenser shells of this I-R condenser are directly connected to the dual side exhausts of the cross-compound 191,000-kw steam-turbine.



AXIAL-EXHAUST TURBINE

Connecting directly to the exhaust of an axial flow exhaust turbine, this condenser of the single-pass rectangular type represents an outstanding example of I-R adaptability.

Ingersoll-Rand

4-487 11 Broadway, New York 4, N.Y.

COMPRESSORS • TURBO BLOWERS • ROCK DRILLS • AIR TOOLS
CENTRIFUGAL PUMPS • CONDENSERS • GAS AND DIESEL ENGINES

FIRST with a COMPLETE LINE OF SAFETY SWITCHES to meet the NEW NEMA STANDARDS

• The table below shows Square D switches meeting new industry specifications. Notice how they clarify conflicting features which existed under old designations. Notice, too, that they establish a new, heavy-duty industrial switch, Type HD.

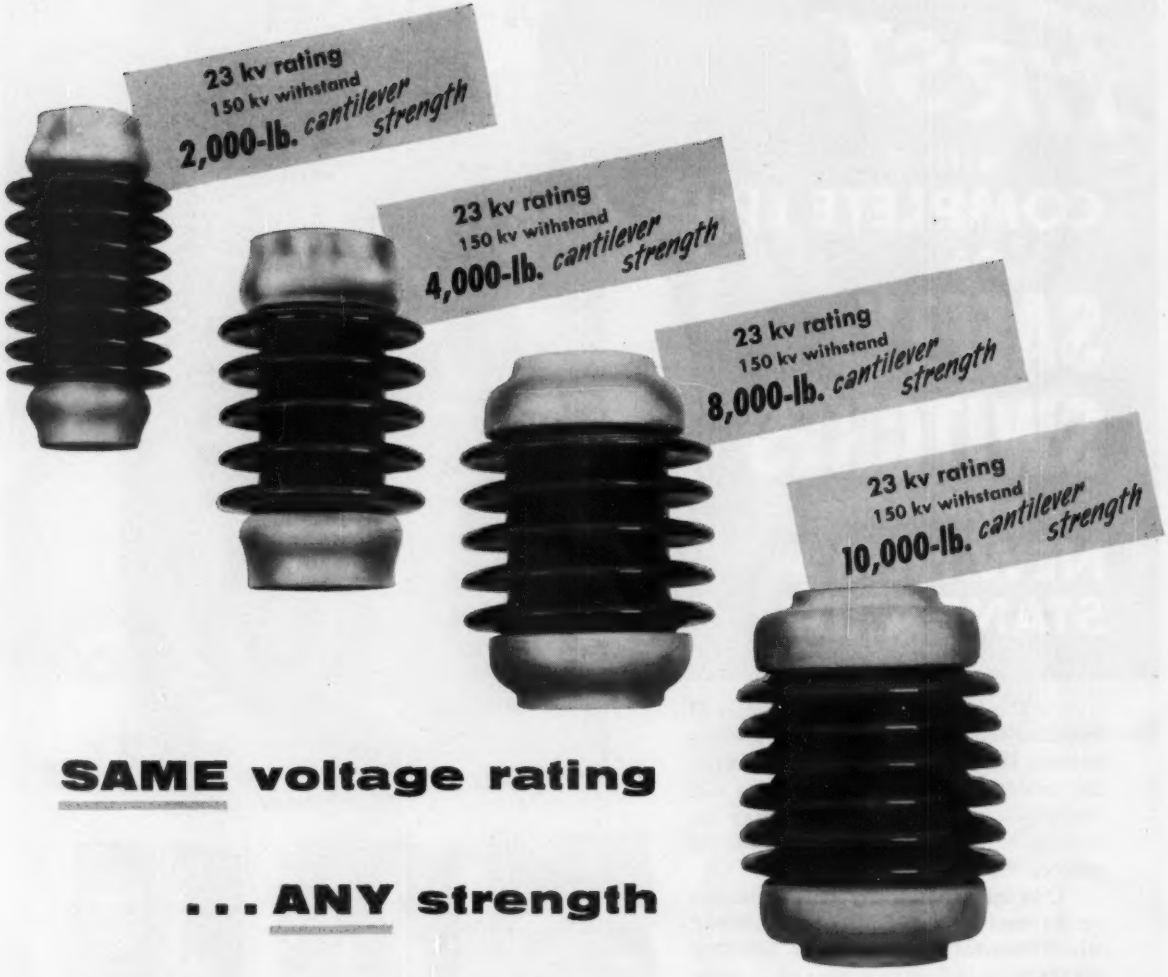
One important thing which remains unchanged is the **DESIGN LEADERSHIP** which has made **SQUARE D SAFETY SWITCHES** industry's overwhelming **FIRST** choice for more than fifty years. Compare them, feature for feature. They cost no more, why settle for less?

TYPE HD TYPE ND TYPE LD

DESCRIPTION	HEAVY DUTY New	NORMAL DUTY formerly Types N, S, or A	LIGHT DUTY formerly Types D or G
Rating-Ampere Voltage	30—600 250 or 600V AC, DC	30—1200 250 or 600V AC, DC	30—200 250V AC
Enclosure	NEMA 12 • Industrial Use (Gasketed) NEMA 4 & 5 • Water-tight & Dust-tight NEMA 7 • Explosion-resisting Class I—Group D NEMA 9 • Explosion-resisting	NEMA 1 • General Purpose NEMA 3R • Raintight	NEMA 1 • General Purpose NEMA 3R • Raintight
Horsepower Rating	NEC Fuse Ratings Dual-Element Fuse Ratings	NEC Fuse Rating Dual-Element Fuse Ratings	NEC Fuse Rating
Operating Mechanism	Quick-Make, Quick-Break Independent of Handle	Quick-Make, Quick-Break Independent of Handle	Positive Make, Positive Break Spring Assisted
Cover	Interlocked & Padlock Attachment	Interlocked & Padlock Attachment	Padlock Attachment
Plating—Current Parts	Extra-Heavy Silver	Silver	
Endurance	Maximum Endurance Far Exceeds UL Standards	Exceeds UL Standards	Meets UL Standards

NOW...EC&M PRODUCTS ARE A PART OF THE SQUARE D LINE!

SQUARE D COMPANY



SAME voltage rating

. . . ANY strength

When substation design calls for buses to withstand high fault currents, there's often considerable economy in use of insulators of high cantilever strengths. Availability of such insulators affords freedom in structure design, and reduces total number of insulators and points-of-support required.

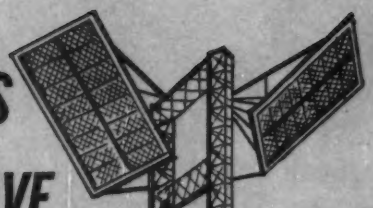
In the illustration above, the insulators shown are, in order, a Lapp Standard Station Post, a Lapp High Strength Station Post, a Lapp Extra High-Strength Station Post, and a "special" Lapp Station Post of still higher strength. It's "special" only because it doesn't happen to be in the most recent catalog, and because it doesn't fit any previously-established formal strength standards. A customer needed 10,000 lb. cantilever strength in a 23-Kv switch and bus insulator. He got it—in a hurry. If you need an insulator of such characteristics, specify it as Lapp No. 41398. If you need switch-and-bus supports in any other strength rating, we can probably make them, too. The merit of the Lapp Station Post design is reflected in the ease of its stress analysis. The simplicity of the post structure, the uniform reliability of Lapp porcelain, and the certainty of externally-attached caps—instead of pins or inserts—all are such that it is routinely possible to design an insulator into an unexplored strength field, without risk of unknown variables.

At any voltage rating, in any strength class, Lapp Station Posts give you an *extra* margin of operating security, low upkeep, long life.

Lapp Insulator Co., Inc., Le Roy, N. Y.

Lapp

DO A BETTER COMMUNICATIONS JOB WITH MOTOROLA MICROWAVE



Motorola multi-channel microwave facilities can transmit:
VOICE • CONTROL • COMMUNICATIONS • VIDEO

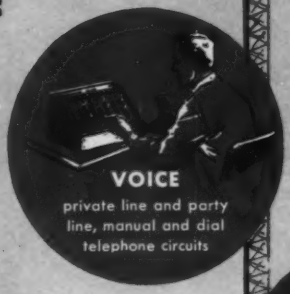
ECONOMICAL The most economical type of multi-channel communication.

EASY TO EXPAND Channels can be inexpensively added.

WEATHERPROOF Maximum protection from failure due to snow, ice, rain, lightning, and high winds.

VERSATILE Spans rivers, swamps, mountains, and busy city streets with ease and is virtually unlimited in length.

PRIVATE Owner has complete control of communications facilities at all times; narrow beam assures private communication.



Modern industry is increasing the emphasis on automation, data transmission, and centralized control in order to provide better protection of personnel and property, better service, and more efficient operation. Motorola microwave can provide the *complete* communications system needed for this type of operation.

More miles of MICROWAVE—IN and OPERATING

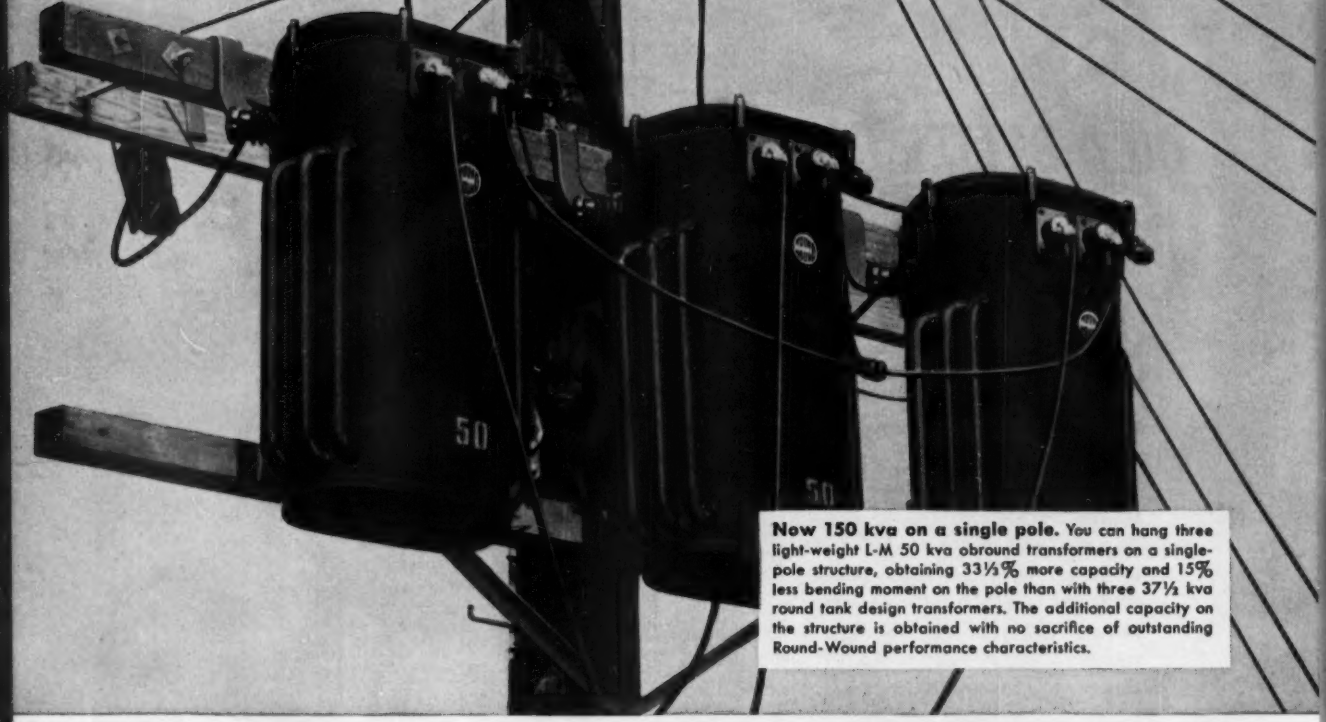
Working dependably over the years, Motorola microwave systems ranging from 7 to over 1000 miles in length are operating in all types of applications and in all kinds of weather. This greater acceptance and experience means engineering and production "know how"—equipment which performs better, lasts longer, and costs less to maintain. These extra dividends repeatedly appear in operational records of Motorola users.

PARTIAL LIST OF POWER-UTILITY INSTALLATIONS

Arkansas Power & Light Co.
Pacific Gas & Electric Co.
Southern California Edison Co.
Northern Indiana Public Service Co.
Idaho Power Co.
Central Illinois Public Service Co.
Illinois Power Co.
Kansas Power & Light Co.
Kentucky Utilities Co.
Louisiana Power & Light Co.
Cleveland Electric Illuminating Co.
Ohio Power Co.
Oklahoma Gas & Electric Co.
Pacific Power & Light Co.
Bonneville Power Administration (USDI)
Ohio Valley Electric Corp.*

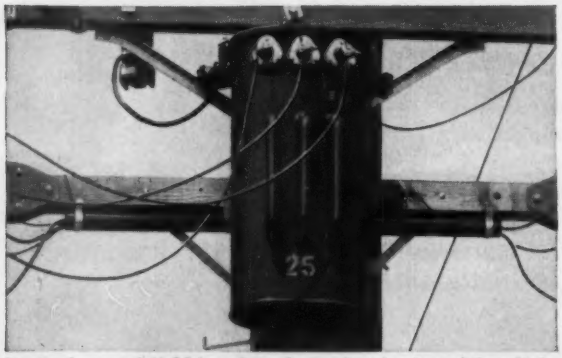
MOTOROLA
COMMUNICATIONS & ELECTRONICS, INC.

The *Complete* Supplier of Radio Communications Systems
Motorola Communications & Electronics, 1400 N. Cicero Ave., Chicago 51, Illinois
A Subsidiary of Motorola Inc.

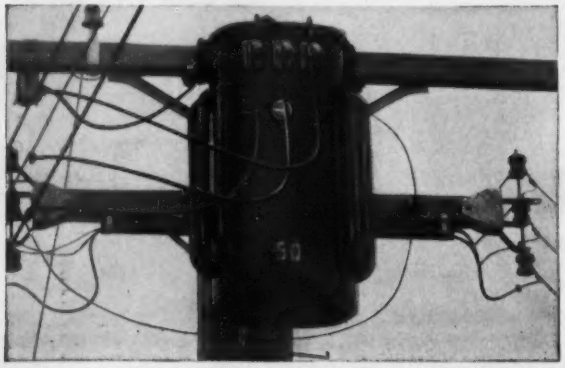


Now 150 kva on a single pole. You can hang three light-weight L-M 50 kva obround transformers on a single-pole structure, obtaining 33⅓% more capacity and 15% less bending moment on the pole than with three 37½ kva round tank design transformers. The additional capacity on the structure is obtained with no sacrifice of outstanding Round-Wound performance characteristics.

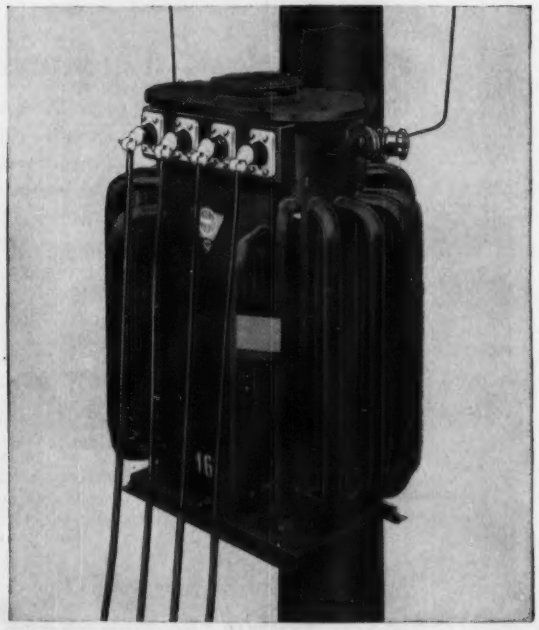
How L-M's Obround Transformer Design



You can hang an L-M 25 kva obround on a class 4 pole, and thus obtain 66⅔% increase in capacity with very little increase in bending moment over a 15 kva round tank design transformer.



You can pole-mount an L-M 50 kva obround transformer and thus obtain 33⅓% more capacity and 15% less bending moment on the pole than with a 37½ kva round tank design transformer.



The light-weight L-M obround 167 kva transformer can be single-pole mounted. In addition to being exceptionally quiet, the overload capacity, regulation, and other Round-Wound characteristics have been fully maintained in this new design.

LINE MATERIAL

A McGRAW ELECTRIC COMPANY DIVISION

Now 500 kva on a two-pole structure. You can hang three light-weight L-M 167 kva obround transformers on a two-pole structure, obtaining 66⅔% more capacity and less bending moment on the pole than with three 100 kva older-design transformers.

Cuts Your Construction Costs

Now you can hang larger-capacity transformers on a pole. Transformer is smaller, lighter, and has shorter moment arm; retains all outstanding Round-Wound® performance characteristics.

By **ALVIN B. COYLE**
Product Manager
Transformers
Line Material Company

The potential capacity of all your transformer structures is greatly increased when you specify Line Material's lighter, smaller, obround transformer. You can now hang three 50 kva transformers on a single-pole structure instead of three 37½'s; or three 167 kva transformers on a two-pole structure, with less bending moment than with three 100 kva older-design transformers.

Less Weight

The new obround design has a smaller tank with less transformer oil, resulting in a lighter, easier-to-handle transformer. Additional cooling tubes compensate for the reduced tank size and provide adequate cooling surface. Transfer of heat from the copper to outside air is faster and more efficient because of reduced mass.

Shorter Moment Arm

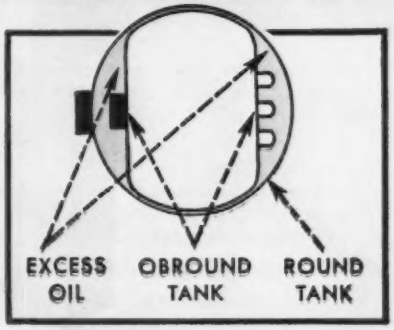
L-M's obround design brings the center of gravity closer to the pole, which reduces the moment arm distance from the pole. The combination of less weight and shorter moment arm distance substantially decreases the total bending moment on the pole and crossarms, and thus greatly increases the potential capacity of all your transformer structures.

Round-Wound Performance

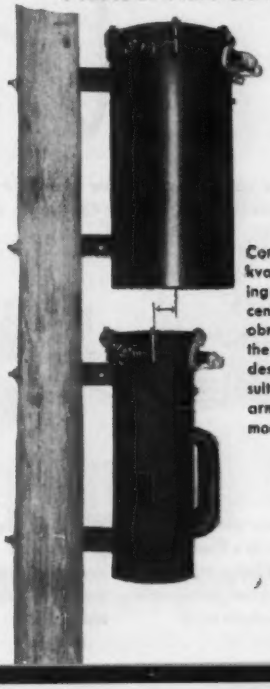
The additional capacity is accomplished without changing L-M's outstanding Round-Wound performance characteristics. These characteristics include low exciting current, low noise level, high impulse strength, high short-circuit strength, high short-time overload capacity and many others.

Get Details on L-M's Obround Transformer

Ask the L-M Field Engineer for application information, weights and dimensions on L-M obround transformers and L-M's exclusive Round-Wound design. Or write Line Material Company, Transformer Division, Zanesville, Ohio.



L-M's obround design has less transformer oil. Additional cooling tubes provide adequate cooling. Transfer of heat from the copper to outside air is faster and more efficient.



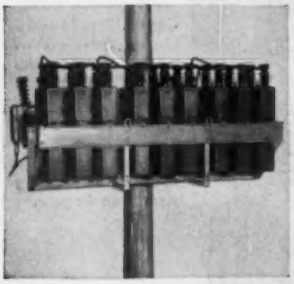
Comparison of two 25 kva transformers, showing how much closer the center of gravity of the obround design is to the pole than the round design, above. The result is shorter moment arm and less bending moment on the pole.

Transformers

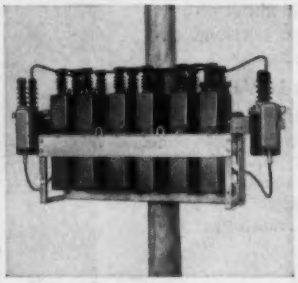
252

L-M's New 50 KVAR

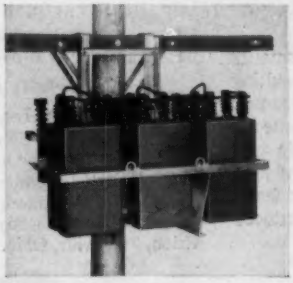
L-M's new 50 kvar capacitors are now available in 600 *kvar switched capacitor racks.* Assembly weighs only 43% more than a 300 kvar rack. Capacitor unit has same width, same thickness as a 25 kvar capacitor and will fit into existing NEMA standard hangers and L-M single-row racks.



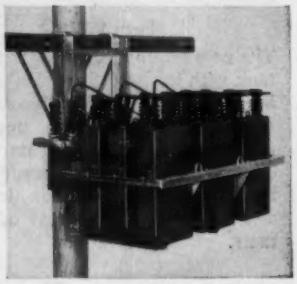
450 kvar single-row switched capacitor rack with L-M's Elemex 50 kvar capacitors. Weighs only 12% more than a 300 kvar single-row rack with 25 kvar capacitors.



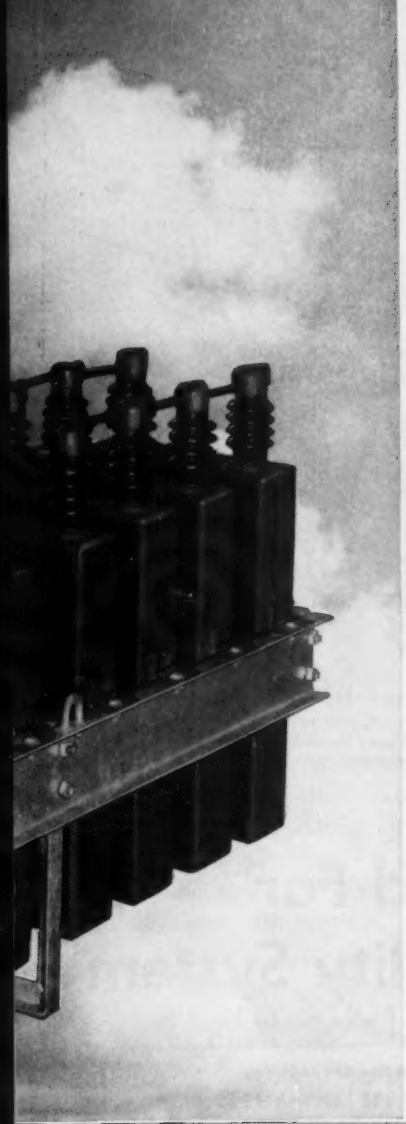
300 kvar single-row switched capacitor rack with L-M's Elemex 50 kvar capacitors. Assembly is quick and easy to install, inspect, and maintain.



300 kvar multi-row switched capacitor rack with L-M's 50 kvar capacitors. Switched racks are supplied with dependable L-M Kyle type NR oil switches.



450 kvar, 2400 volt multi-row switched capacitor rack with L-M's 50 kvar capacitors. Weighs only 150 pounds more than a 300 kvar rack with 25 kvar capacitors.



L-M's New 50 KVAR Capacitors Provide Greater Capacity Per Pole

Offer less weight and less pole space per KVAR

By **N. K. DELANEY**
Product Manager
Capacitors and Regulators
Line Material Company

Now you can hang capacitor racks of larger capacity on a pole with L-M's new 50 kvar Elemex® capacitors. Racks are factory-assembled and wired, shipped ready to install on distribution systems rated 2400 to 13,800 volts, multi-grounded wye. Bank sizes may be up to 450 kvar switched, 600 kvar unswitched multi-row racks, and up to 600 kvar switched or unswitched single-row racks.

Less Weight per KVAR

Line Material's new 50 kvar, 2400 volt capacitor weighs 109 pounds compared to 68 pounds for a 25 kvar unit. A 600 kvar, 2400 volt unswitched multi-row rack weighs only 51% more than a 300 kvar rack, and a 600 kvar, 2400 volt switched single-row rack weighs only 43% more than a 300 kvar rack.

Less Space per KVAR

L-M's new 50 kvar unit has the same width, same thickness as a 25 kvar capacitor and only 10 inches of additional height. It fits into existing NEMA standard hangers and into L-M's present single-row rack. Capacity of a single-row rack can be *doubled* with L-M's 50 kvar capacitors. A 450 kvar single-row switched rack with 50 kvar capacitors is approximately 2 feet narrower than a 300 kvar rack with 25 kvar capacitors. Handling, installation and maintenance costs per kvar have all been reduced with L-M's new 50 kvar unit.

Other Features of L-M's Elemex Capacitors and Capacitor Rack Assemblies

Elemex capacitors are individually dried and completely impregnated under vacuum with low-temperature Elemex liquid dielectric.

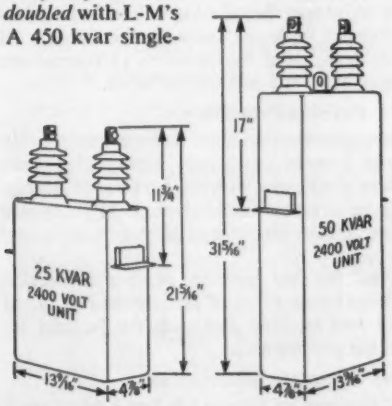
Unit has strong solder-sealed bushings of one-piece wet-process porcelain, "Paragroove" clamp-type connectors, and aluminum metallic coating under alkyd resin paint.

Assemblies have only one plug-in connection point per phase for control wiring, and one terminal box for all three phases.

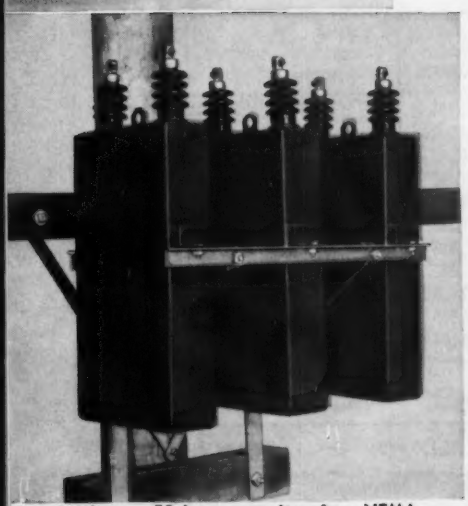
Assemblies are of complete bird-proof construction; terminals have neoprene rubber caps, plus 5 kv insulated conductor for high-voltage connections.

Get Complete Information

Ask the L-M Field Engineer for information on features, design, and delivery on the new 50 kvar Elemex capacitors and capacitor equipments. Or write Line Material Company, Milwaukee 1, Wisconsin (a McGraw Electric Company Division).



Only 10 inches of additional height gives twice the capacity.

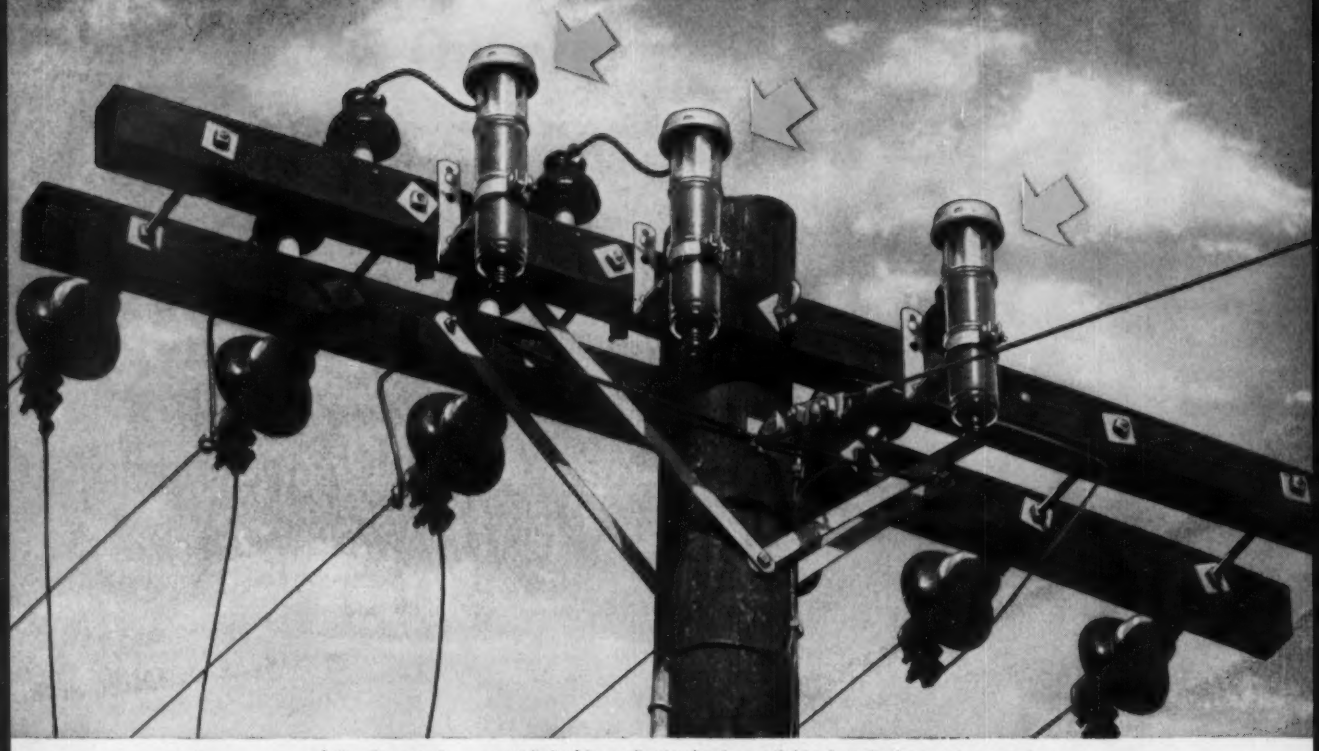


L-M's new 50 kvar capacitors in a NEMA standard hanger. The capacitor has the same width, same thickness as 25 kvar capacitor and 10 inches of additional height. The three units provide 150 kvar—50% more than four 25 kvar units.

LINE MATERIAL

243

Elemex® Capacitors



L-M valve arresters are not limited in application by the available short-circuit current; pass only small values of follow current regardless of system capacity. Heavy-duty spark gap transmits severe discharges without burning or pitting, and allows the arrester to go into action fast.

Eleven-year operating records show...

99.96% Performance Record For L-M Valve Arresters On Utility System

Eleven-year operating records of a large midwestern utility show that L-M valve-type lightning arresters have an outstanding performance record. During this time, L-M valve arresters have accumulated 138,110 service years on this system, and only 51 of these arresters have failed during this span as evidenced by proper functioning of the isolator. Of the 1,873 L-M arresters removed from service because of system changes, all were passed by the utility's electrical test and inspection department and returned to stock.

Positive Protection

L-M valve arresters provide optimum balance between 60-cycle sparkover and impulse sparkover. Heavy-duty spark gap transmits severe discharges without burning or pitting, and allows the arrester to go into action fast. L-M's exclusive valve element assures maximum surge discharge capacity and minimum I.R. drop.

The L-M patented Isolator provides positive protection against feeder lockout in the event of an arrester failure. If the arrester should ever become damaged, the Isolator instantly disconnects the ground lead.

Get Complete Information

Ask your L-M Field Engineer for Bulletin LA-2 on L-M's Type E arrester, which gives specific information on arrester design and performance. Or write Line Material Company, Milwaukee 1, Wis. In Canada: Canadian Line Materials, Ltd., Toronto 13, Ont.

Here are the records for the years 1945 through 1955

Year	Arresters In Service	Isolator Operations In Service	Arresters Tested	Arresters Failed In Test
1945	3,286	5	0	0
1946	4,322	2	11	0
1947	6,020	2	137	0
1948	7,469	4	118	0
1949	8,686	3	186	0
1950	11,392	7	161	0
1951	13,950	3	270	0
1952	15,282	7	204	0
1953	20,498	13	158	0
1954	21,105	2	383	0
1955	26,100	3	245	0
Total Arrester Service Years	138,110	51	1,873	0

51 ÷ 138,110 x 100 = .036% Failure Rate

379

LINE MATERIAL Lightning Arresters

A McGRAW ELECTRIC COMPANY DIVISION

The Big and Little of Reactor Development

Goal of the utility industry's atomic program today is to seek out and develop nuclear reactors that have promise of becoming efficient power producers. It is important that this search and development program be executed with all the precision and dispatch that is consistent with careful scientific evaluation. In this regard the U.S. is fortunate that its fuel resources are sufficient to remove the investigation from the realm of panic or "crash" programs, growing out of fuel scarcity.

How then can this search and development program be most prudently and effectively advanced? Is it by building commercial-size reactor power units requiring high initial outlay and risking high annual fixed charges and operating expense over the unit's life? Or is ultimate economic atomic power development better advanced by resort to small prototype units that can be installed in greater number to cover a wider range of experimental reactor types for the same dollar outlay but with lower annual fixed charges and operating expenses per reactor.

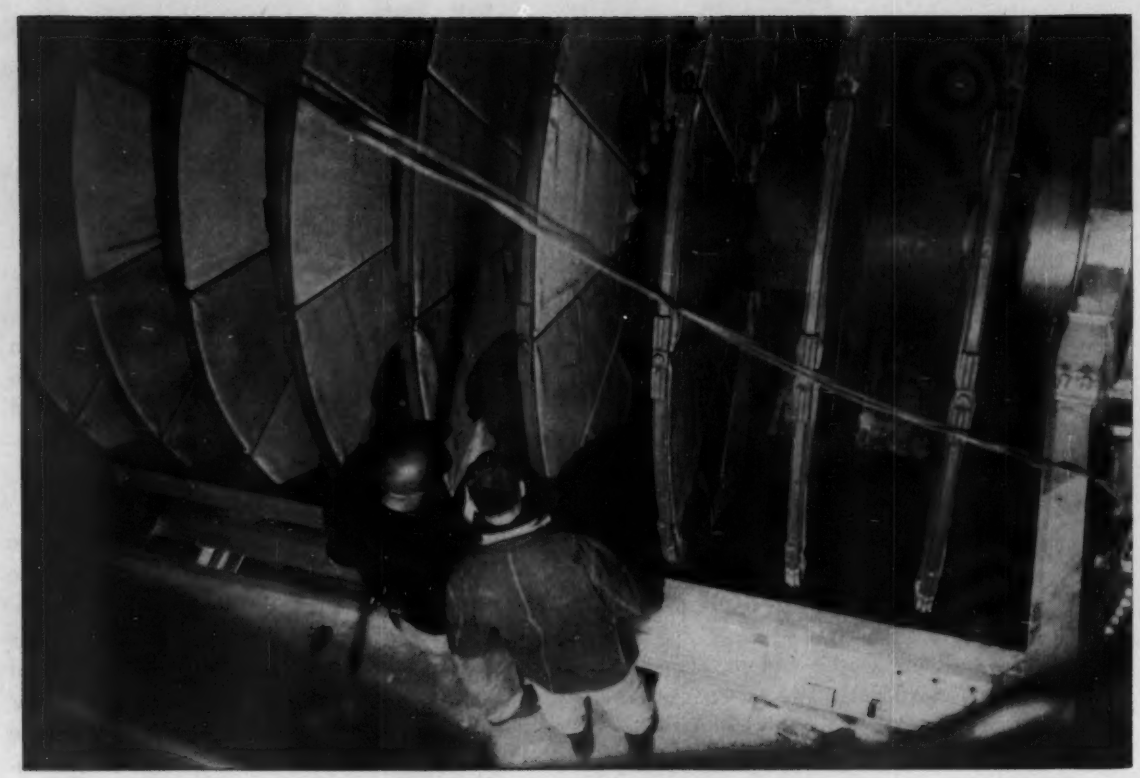
How these questions are resolved will depend on what is necessary to fulfill the industry's greatest need in this field. Certainly per kilowatt capital cost of a given size reactor need not necessarily be the primary concern of the investigators at this stage. Nor do the investigators need to be unduly concerned *now* with the probable economics of atomic power generation. It would seem that experience, training, and new knowledge are their most logical objectives in today's program of development.

In this field of atomic power the need for experience is great, experience in designing, constructing, operating, and maintaining all the practicable types of power reactors. But even before these reactors can be put in operation to secure such experience, other research and development expenditures must be made to develop prerequisite technology.

As we see it, this needed research, experience and knowledge can best be attained in the case of untried reactor types by resort to small prototype reactors (10,000 to 30,000 kw). This leaves reactors of relatively more established feasibility free for installation in the larger sizes. Certainly more untried types could be explored in this way and more knowledge developed for a given total expenditure of money. There is ample indication that the utilities are thinking along this line. Moreover atomic experts agree that nearly as much can be learned from small prototype units as from larger units.

But there are two factors which might appear to be in conflict with this approach. One is the Atomic Energy Commission's attitude favoring two specific types of large reactors in the next round of its Power Reactor Development Program. The other is that such a course opens the utility industry to the false charge by federal power advocates that electric companies aren't really serious in their endeavor because they are experimenting with prototype reactors rather than commercial size units.

Such criticism to the contrary, today's need in the nuclear power field is for experience through action. And if building small reactor units is the most prudent approach, it should be done by the utility industry.



These webbed vanes of a vacuum filter get checked as . . .

CEI's Coal Pipeline Enters Final Testing

- **Mushy-like, 50-50 coal-water slurry to be pumped 108 miles from Pittsburgh Consolidation Coal Co's mine to utility's 660-Mw Eastlake Plant**

- **But successful test runs won't herald a sweeping change in coal transportation methods**

The 108-mile-long coal pipeline linking Georgetown, Ohio, with Cleveland Electric Illuminating Co's Eastlake plant is scheduled to enter its final phase of testing this week. It is to begin carrying a mushy-like substance—50% coal and 50% water—to CEI's three-year-old, 660-Mw station.

When it begins operating on a 'round-the-clock basis, probably in April, the line will dump 3,500 tons of coal a day into surge basins on CEI's end.

Transportation cost savings have been estimated as high as $1.50 a ton. Cleveland Electric's own engineers estimated $1.00 a ton at the outset, but higher savings may be achieved if coal prices hold firm (which they probably won't) and transportation costs climb (which they probably will). At any rate, CEI states officially that it expects "substantial" savings. Last year CEI paid about $6.42 per delivered ton of coal.

The 10¾-in. welded pipeline is owned by Pittsburgh Consolidation Coal Co, and represents a $12-million investment. It requires three pumping stations along its length, and a work crew of three men per shift. Dewatering facilities at CEI's end cost Pitt Consol $2.5 million. CEI will operate these facilities, however, and will assume ownership of them after 15 years. CEI also has an option to buy the line at the end of the 15-year period.

Pitt Consol expects no big "bugs" to appear during the tests—for the scheme is fairly simple.

Coal Is Sized Carefully

After being strip-mined, coal is washed, cleaned, and sized to pass through a 14-mesh screen. The line empties into two 20-ft-deep concrete surge tanks or basins. The slurry is agitated by rotating arms on the bottoms of the tanks, to which scrapers are attached.

At this point the slurry loses about 5% of its water content through overflow and attrition.

The slurry then is piped to four vacuum filters in the nearby drying house. Each filter is about 20 ft long and 10 ft in diam, and is fitted with 13 rotating vanes. One filter's vanes is equipped experimentally with stainless steel instead of the conventional seran-type textile material covering.

A vacuum inside the vanes helps draw water from the slurry as the

vanes rotate. Extracted water is recovered and piped back to the flocculation basin.

There the water is treated with animal glue to coagulate and settle any remaining coal particles so they may be returned to the surge tanks. The cleaned water is purified chemically and used as plant service water—but not for boiler makeup —or is emptied into Lake Erie.

In 840,000 gal of treated water a day, there will be but 63 lb of solid matter returned to Lake Erie. This water will be non-toxic and 99.9% pure.

Coal sticking to the vacuum filter vanes is scraped and blown off near the end of the cycle. Coal recovery at this point is about 97% complete.

Coal Dried in Columns

Still containing 20% moisture, the coal is conveyed to a 65-ft-high drying column—each filter having its own. These columns are served by furnaces which supply 1,200F air at high velocity.

As moist coal is sprayed in, the hot air sweeps it upward into collectors. Now having a 5% to 6% moisture content, the coal goes by gravity to a storage bin for conveying to the plant's boilers. It is ground to pass a 200-mesh screen before being blown into furnace.

Pipeline Termed "Experimental"

This pipeline, which will carry 1¼ million tons a year, or about 80% of Eastlake's fuel requirements, is still considered experimental. All agree, however, that it does not signal a complete revolution in coal transportation methods.

Whether the pipeline idea will expand into a supply network depends largely upon future rail costs. Pipeline advocates see each rail rate hike as forcing some utilities to take another step in the pipeline's direction.

Potential partners with Pitt Consol are three railroads, each holding an option of 15% ownership in the venture. These are the Pennsylvania, Nickel Plate, and New York Central railroads.

It has always been understood that Pitt Consol accorded the railroads the privilege of buying into the venture in return for ready consent enabling the pipeline to cross railroad property.

Coming: Special U-g Rates?

Southern California Edison now has PUC's approval of a schedule applying to systems built at the utility's expense but not for its own convenience

The growing need for underground power networks may lead eventually to new, special rate schedules. As a sign pointing to this possible trend, Southern California Edison Co has received an official OK on its proposed schedule covering service from underground systems built at its expense, but not for its own convenience.

In authorizing "Rate Surcharges for Service from Designated Underground Distribution Systems," the Public Utilities Commission noted that the utility will be required to maintain these records to prevent discriminations:

- Names and addresses of affected customers.
- Cost of underground system and estimated cost of equivalent overhead.
- Date of installation and estimated life of facilities.
- Rate schedules being applied.
- Total annual revenue.
- Revenue from surcharge received from service to such installations.
- The reason why the surcharge is being applied.
- Customer density in the area.

The commission said there is "a real advantage in having such a schedule . . . and the authorities which may require Edison to install underground distribution at the company's expense will be properly advised ahead of time as to the rate effect of such action."

Edison based its need for the special rate on computations which indicated the cost ratio of underground plant to overhead is about 7.3:1. Based on system-wide plant records, underground conduit was determined to be 11.9 times as costly as poles per mile of line, underground conductors 9.5 times as costly per mile, line transformers 1.5 times as costly, and underground services 7.0 times as costly. Weighting these ratios yielded the 7.3:1 figure.

Determination of the fixed annual cost of the additional investment of 6.3 times overhead cost, taking fixed charges at 16%, resulted in an annual factor of 1.01, or a monthly factor of about 0.08. Application of this factor to the rate base for cost-analysis customer groups produced the additional monthly revenue requirements.

Residential Surcharge

Cost analysis indicated a commodity and demand charge total of 1.58¢ per kwhr and a customer charge of $2.42 for residential consumers. To keep the kwhr surcharge low to avoid restriction on residential use of electricity, the final proposal is for a 0.5¢ per kwhr surcharge plus a $4.25 monthly customer charge.

For lighting and small power group, cost analysis indicated a commodity and demand charge total of 1.40¢ per kwhr and a customer charge of $5.30. For this group Edison proposed a surcharge of 1.0¢ per kwhr plus an $8.00 monthly customer charge—except for two schedules where the surcharge would be 0.5¢ per kwhr plus $1.20 per hp or kw of connected load plus an $8.00 customer charge.

Industrial Surcharge

For the large power group served at distribution voltage, the cost analysis indicated a commodity charge of 0.72¢ per kwhr, a demand charge of $1.53 per kw of billing demand, and a customer charge of $49.50. Edison proposed a surcharge of 0.5¢ per kwhr, plus a demand surcharge of $1.70 per kw of billing demand, plus a customer charge of $8.00.

"Applicant's proposed surcharges are predicted on average conditions and are segregated by classes," stated the PUC. "In the proposed surcharges, schedule by schedule, applicant used its judgment and took into account additional factors beside cost, more or less, as the commission would do in prescribing rate levels. Pending further experience with this schedule the rates will be authorized at the levels suggested by applicant."

Florida Powder Keg: Fuel Oil Fuse Is Lit

Utility group bristles over $30-million boost, tells Congressional committee price controls and higher residual output are needed. Increase now equals $3/ton of coal

Recent fuel oil price increases are going to cost Florida electric users $30 million a year.

The increase, in a state almost wholly dependent on oil for power generation, has prompted a Florida utility delegation to ask Congress for action against the oil industry.

The delegation, consisting of representatives of private and municipal utilities and the Florida Railroad and Public Utilities Commission, told a Senate anti-trust and monopoly subcommittee investigating the oil price rise that the state needs immediate relief.

Complained McGregor Smith, chairman of Florida Power & Light Co:

- The increase will add $6 million a year to his company's fuel costs.
- If a comparable (on a BTU basis) increase was applied to coal it would equal $3 a ton.

Smith had his strongest criticism for the oil industry itself.

His company, he said, had never bought fuel oil on a truly competitive basis, although the fuel bill was larger than the payroll. Florida P&L has never made an oil contract for any given length of time at a fixed price.

"It is strange that (they) cannot contract for a year or even a month at a definite price for the residue remaining after removing the more valuable refined products," he said.

If the oil industry, described as the most profitable in the economy, can make this price increase stick in the face of efforts to control inflation, "then there is no need of trying to close the barn door, and I doubt if it would be worthwhile to try and find the horses," Smith said.

Alan S. Boyd, R&PUC chairman, said the boost will cost the city of Jacksonville $1 million a year. But all Florida power consumers will feel the pinch. Most rate schedules have fuel adjustment clauses, and increases will be passed on, said Boyd.

He urged that Congress subject the oil industry to some "remedial or corrective legislation." Many people in the state were wondering why natural gas prices were so closely regulated by Federal Power Commission while there was no control over the price of oil, he told the committee.

Boyd raised the point that the oil industry's method of financing capital expenditures might have some bearing on oil prices and perhaps would bear investigating.

Of $12 billion needed for capital expenditures in 1950-55, less than half a billion was obtained from long term debt or sale of capital stock while the rest came from internal sources, Boyd claimed. If regulated utilities raised most capital requirements internally, he added, rates for such funds would be about 50% higher than now.

J. Dillon Kennedy, Jacksonville public utilities commissioner, said the city had absorbed a 22.4% hike in fuel oil costs since 1953. The "recent unwarranted increase" would add another 22.8%.

WASHINGTON COMMENT

Steam Plants Evaporate 0.2 Gal of Water Per Kwhr

V. CRAIG RICHTER, Washington Correspondent

Electric utility steam plants, although large users of water, are among the least wasteful of water supplies of any industry in the country.

This is clear from a recently-completed study of steam plant water usage carried out by the Federal Power Commission.

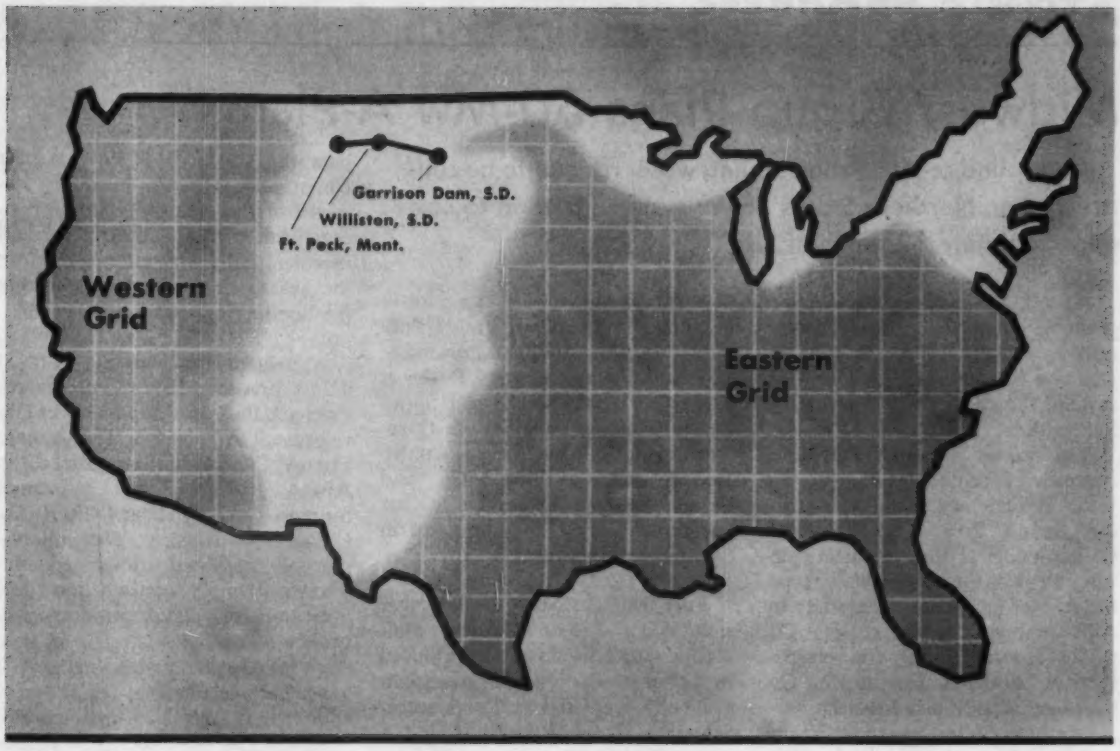
From time to time there have been complaints that steam plants lose considerable volumes of water by evaporation. At a time when drought conditions in many parts of the country have focused attention on water supplies, the new study takes on particular significance in such a debate. The findings: Steam plants lose only 0.2 gal per kwhr by evaporation.

Total use of water per kwhr, according to the survey, is around 75 gallons. This is higher than the generally accepted norm for steam plant operations but it includes 8.8 gallons in recirculation use. Total intake actually is 66.2 gallons per kwhr.

The FPC survey was requested by the Bureau of the Budget and covers the year 1954. Previous total figures on steam plant water usage have been estimates and the 1954 study now provides a yardstick year on which to make more accurate forecasts of future water usage.

The FPC survey is part of an overall study of all water usage for the country being compiled by Walter L. Picton, head of the water and sewage industry and utilities division of the Business and Defense Services Administration. The completed report will relate utility water usage to that of other industries, and project future requirements in various fields. It will become available to the public later this year.

With this information, related to the availability of water, it will be possible to make more accurate determinations of where to locate future steam plants. The study will also furnish states or geographical regions with the information necessary to plan water resources developments to cope with future growth.



East-West Power Link Holds Nearly 6 Min

The eastern power grid was tied to the western grid Jan. 27 at Ft. Peck, Mont., in an experiment aimed at yielding data on synchronizing power swings, and the effect of interconnection on both systems, reports Bureau of Reclamation engineers.

Although two attempts at keeping the networks together proved that such a tie is not feasible, the experiment did point up what has to be done to enable future transfers of excess system power to areas east or west of Ft. Peck as needed.

The tie was made through a breaker across 13.8-kv buses in Ft. Peck's switchyard. One of these buses ties a 15-Mva hydro generator to the Bureau's 161-kv line running west to the Northwest Power Pool. The other bus ties two 35-Mva hydro generators to the 115-kv transmission link to USBR's Missouri River system.

At the time of the coast-to-coast tie, up to 8 million kva was being generated in the Northwest Power Pool and up to 60 million kva, in the eastern grid.

Both systems were close to 60 cycles when the air circuit breaker closed the circuit. Initial power and reactive swings were small, but climbed rapidly to 35 Mw. The Garrison 115-kv line oil circuit breaker at Williston, N. D. (not S. D. as shown in map), was tripped by its HZM phase relays to separate the systems 5 min 40 sec after initial closure. A second try operated for one minute.

Automatic Adjustment Too Slow

During tests, sync swings passed through 890 miles of the USBR system in Montana, North and South Dakotas, and were too fast to be affected materially by automatic generation changes in the USBR system.

(BPA's system regulates flat frequency for Northwest Power Pool and its interconnected systems regulate net interchange and frequency bias. Eastern interconnected systems regulate largely the net interchange—with frequency regulation, on the bias principle, being the joint responsibility of all systems.)

When East and West systems were tied in at Ft. Peck, the excellently regulated eastern frequency was imposed on BPA's system—virtually eliminating the action of its frequency-sensitive generation control devices. This resulted in the eastern system largely accommodating BPA's internal load changes.

To Make Interchange Work:

USBR suggests that continuous closure is infeasible until BPA converts to net interchange and frequency bias control, Montana Power Co and USBR include mutual boundary interconnection in their respective net controls, and certain ties are strengthened.

Bureau engineers recognized that tie-in success was remote. Calculations showed that, under steady-state conditions, the tie lines could carry more power than the continuous rating of the 13.8-kv breaker and could handle 40 to 50 Mva within transient stability limits. But network analyzer studies did not offer much hope. However, engineers wanted to check their feeling that actual sync currents would be within the limits of breaker and tie lines.

Midwest Group Plans 60-Mw A-Plant

Controlled re-circulation boiling water reactor to be constructed on Northern States Power system. Station to cost approximately $25 million

A 60,000-kw nuclear power plant is planned by ten Midwest utilities. Slated for construction on a site on Northern State Power Co's system, the station will cost $20 to $25 million.

The reactor is expected to be of controlled re-circulation boiling water design, according to Northern State's Pres Allen S. King. Called a logical step in further development of the boiling water type, the reactor has been under study by Allis-Chalmers Manufacturing Co, prime contractor for the project. Pioneer Service & Engineering Co, Chicago, is architect-engineer.

Northern States' interconnections with participating companies and system size were factors determining site locale, King said. Completion date is 1962.

Participants are, besides Northern States, Mississippi Valley Public Service Co; Otter Tail Power Co; Interstate Power Co; Iowa Power & Light Co; Iowa Southern Utilities Co; Wisconsin Public Service Corp; Northwestern Public Service Co; St. Joseph Light & Power Co; and Central Electric & Gas Co. Other companies expect to join these in the near future.

Fuel element strut failure that shut down Britain's Calder Hall atomic power station was induced by higher irradiation creep rate than originally predicted at design stage. Scientists, however, have found a cure. Central Electricity Authority designs now incorporate in the support of the lower fuel elements a system of restraint which would bypass the Calder Hall trouble. Sir Christopher Hinton, managing director of the country's Atomic Energy Authority's industrial group, revealed that it was only just before the reactor became divergent that the bursting occurred.

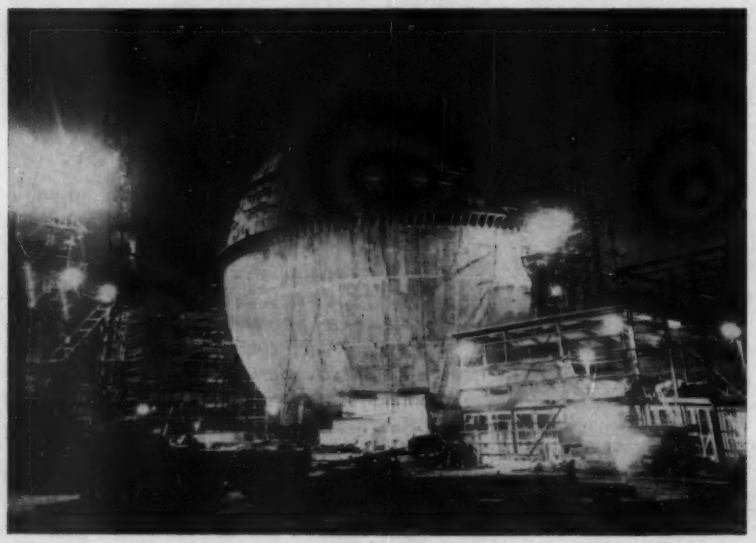
A Belgian firm planning to build a fast breeder reactor will get restricted data from Atomic Power Development Associates. The Atomic Energy Commission authorized the APDA exchange and personnel training aid to Syndicat D'Etude De L'Energie Nucleaire. The collaborate is expected to speed the foreign group's construction and operation of plants producing a variety of reactor materials in Belgium or the Belgian Congo. Advancements gained by SEEN will complement the U. S. reactor designers. The APDA-SEEN agreement runs to June 1958.

A nominal power rating of 100,000 kw is the goal for the second core of the Shippingport pressurized water reactor. Westinghouse Electric Corp is the designer.

AEC has announced that Gilbert Associates, Inc, Washington, D. C., is designing a 20,000 kw nuclear plant for construction overseas.

A group of Florida utilities have signed a contract with Dr Walter H. Zinn, president of General Nuclear Engineering Corp, for nuclear consultant-advisor services. Florida Power & Light Co, Tampa Electric Co, and Florida Power Corp are studying reactor types to select an appropriate design for possible construction in their areas.

A nuclear power program that would produce 15-million kw by 1967. This is the dream of the still unratified Euratom, a six-nation atomic energy agency. The backers would halt conventional power station construction by 1961. Initially plants would be evenly divided between pressurized water reactors (purchased mostly from U.S.) and gas-cooled reactors.



Britain Reactor to Use Fast Neutrons

The fast breeder reactor of Britain's Dounreay, Scotland, plant will depend on fast neutrons for its chain reaction. The unit, similar to the type proposed by Power Reactor Development Corp, will manufacture more atomic fuel than it consumes. This night view shows the 135-ft hermetically sealed sphere that will house the reactor by the end of 1957.

What Does High Interest Mean to Utilities?

Unhappy lesson in timing marks the year's early impact of high interest rates

After brief peak yields, the bond market marks time

The question most commonly asked these days is "What will be the impact of high interest rates on electric utilities?"

Interest rates on their funded debt have been on a high plateau since August of last year. New Year's week saw a traditional small number of new offerings, but before the week of Jan. 7, was half over, interest rates on funded debt had pierced all previous tops for decades past.

An offering of New England Telephone & Telegraph Co 4¾% debentures carried a yield of 4.65%, highest since 1929. Accumulated substantial offerings, both of utilities and industrials, deferred by the holidays, all coming together, caused this debacle in bond yields. But in a few days, new issues were selling above their offering prices, indicating the pessimism had been overdone. The result: a lesson in unhappy timing.

Yield Trends of Security Issues Offered by Electric Utilities

(JANUARY 1957)

Company	Issue	Moody's Rating	Principal Amount	Offering Date	*Yield on Basis of Offering Price	Price 2/5
BONDS						
Idaho Power	4½s 1987	Aa	$20,000,000	1/8	4.50	4.36
Oklahoma G&E	4½s 1987	Aa	20,000,000	1/18	4.43	4.36
Pacific G&E	4½s 1987	Aa	35,000,000	1/23	4.50	4.35
Atlantic City Elec	4½s 1987	Aa	10,000,000	1/24	4.40	4.36
Niagara Mohawk	45/8s conv. debs 1972*	A	46,224,200	1/11	4.625	3.92
Louisiana P&L	4⅜s 1987	A	20,000,000	1/16	4.67	4.39
Southwestern G&E	4⅝s 1987	A	10,000,000	1/22	4.56	4.25
Pacific P&L	5⅜s 1987	Baa	12,000,000	1/10	5.20	4.96
PREFERRED STOCK						
Pacific P&L	90,000 shs 6.16%	...	.....	1/10	6.00	.....
Western Light & Tel	5.20% conv.	...	.....	....	5.20	.....
COMMON STOCK						Closing price 2/5
Illinois Power	200,000 shs	...	.....	1/7	$56.375	$58.375
Northwestern PS	54,120 shs*	...	.....	1/9	15.00	16.625
Southwestern PS	291,967 shs*	...	.....	1/17	24.50	26.875
Ohio Edison	580,617 shs*	...	.....	1/31	46.50	48.75

* Offered for subscription to company's stockholders.

Bond Market Marks Time

Since this partial recovery from temporary peak yields, the bond market has tended to mark time.

It has been assumed that electric utilities had contributed their share of debt securities, which brought about high yields since August. Recent figures dispel this view.

They indicate about a 5% decline, both in funded debt and other types of security offerings of electric utilities, in 1956 as compared with 1955.

Total offerings of electric securities for new money increased about 3%, but a drop in refunding issues brought about the over-all decline. These percentages reflect both public offerings and private placements.

Another assumption has been that the unfavorable late '56 public market channeled many offerings into private placement and thus materially increased the amount so disposed. This, too, was erroneous as to electric utility debt; 1956 private placements of such securities were less than half that of '55.

Economic significance of these '56 figures seems obvious. It was primarily industrials which stepped up expansion and financing. This created the extra supply of debt securities which brought about much higher yields for all types of senior securities.

How long will pressure of this expansion and the financing thereof continue? Estimates put 1957 business expansion spending 10% above 1956. So easing this pressure seems unlikely, unless expansion flattens out later this year.

Until a flattening occurs, it's hard to see how lower long-term yields can be expected.

As for other high yields, Boston & Maine Railroad issued equipment trust certificates on a 6.15% basis in late January. And New York Central's system must pay around 5.5% for funds derived from a similar sale.

Nor is there any balm in shorter term issues. Treasury bills are still taken at well over 3% (3.2% is the recent average). Every category of short term money has nudged its interest rates upward.

One recent good tiding: Federal Reserve Board did not increase the rediscount rate when it was up for consideration. But Chairman William McC. Martin's statement left little doubt of FRB's intention to pursue a hard money policy, despite somewhat equivocal Administration statements.

Some experts believe by mid-1957 a softening of interest rates will occur. The most optimistic factor for interest rates at the moment is the record heights to which they have risen. This should leave more space for a retreat than a further advance. But such generalities weaken forecast accuracy.

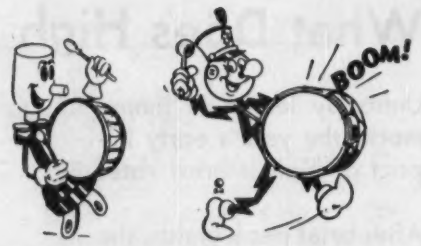
Offerings Scheduled

Turning to offerings scheduled for February and March, utilities are planning to offer around $600 million of funded debt of which about $300 million covers electric utilities. March figures include $250 million of American Telephone & Telegraph Co debentures, which must be considered, since it is expected these debt securities will not be convertible. These totals are above any two-month offering average of such securities in 1956.

In addition, February and March will see new industrial bond offerings of over $287.5 million and electric, gas, and other firms coming to market with common stock totaling over $288 million.

Willie Wiredhand Wins . . .

. . . and is in business to stay. Co-op symbol is ruled not "an infringement or confusingly similar" to old-timer Reddy Kilowatt



"Willie Wiredhand," rural electric cooperatives' symbol for electric service, is in business to stay. A federal appeals court has ruled that he may co-exist with Reddy Kilowatt, the widely known little character who humanizes electricity for over 200 U. S. electric companies.

The fourth circuit U. S. Court of Appeals, in upholding a lower court decision, ruled that "Willie" was not an infringement nor confusingly similar to "Reddy." Effect of the action is to set aside a plea by Reddy Kilowatt, Inc., that the National Rural Electrification Association and individual cooperatives be enjoined from using the "Willie Wiredhand" symbol.

In connection with the element of confusion between the two service marks, the courts considered the question of competition. The appeals court noted that the (Reddy Kilowatt) trade mark or service mark is used to denote the origin of the promotional material supplied to electric utilities by Reddy Kilowatt, Inc, and is also used by the utilities to denote the origin of the product or service supplied by them to the public. "In neither respect," ruled the court, "does the (Reddy Kilowatt) mark encounter substantial competition with the defendent's mark (Willie Wiredhand)." The opinion continued, "Similarly, there is no substantial competition between the suppliers of electricity that use one mark with the suppliers . . . that use the other."

Commenting on the decision, Ashton B. Collins, president of Reddy Kilowatt, Inc, and originator of the "Reddy" symbol, said the outcome of the case does not affect the use of his symbol by licensed companies.

Why 2 States Passed Up St. Lawrence Power

Massachusetts and New Hampshire cite high cost of transmission as major reason for withdrawing bids. Local expansions are now favored

Massachusetts and New Hampshire utilities commissions have disclosed the reasons for their recent decision to withdraw their requests to the Federal Power Commisison for allocations of St. Lawrence River power. Major factor in their decisions was the anticipated high cost of transmission of this power from the 1,800-Mw Barnhart development near Massena, N. Y.

D. M. Brackman, chairman of the Massachusetts DPU, said a survey made for the state by Stone & Webster Engineering Corp showed that the cost of the requested 250 Mw delivered centrally in that state would be equal to or greater than the cost of power generated and distributed from a steam plant located in Massachusetts.

The New Hampshire commission made a similar announcement based on a study made by its engineers. It pointed out that transmission of 100 Mw of St. Lawrence power would burden the state with a $20-million investment. This figure, it said, would include installation of high tension lines and equipment, creation of a new agency to administer the work (with operation, maintenance, and fixed charges of about $3-million yearly), and loss of tax revenues from private sources.

This same private local utility development, it declared, could be used to benefit local employment through expansion programs.

Rate Estimates May Be Low

In addition, the commission said that there would be no assurance from the New York Power Authority that rates for purchase and transmission of St. Lawrence power may not be higher than now estimated. It declared that "New Hampshire cannot justify a venture of such huge proportions without a certainty of substantial savings."

The Stone & Webster report analyzed several projects for 250 Mw maximum transmission at 230 kv from Massena to Pratts Junction, a New England Electric System transmission station located in central Massachusetts. Cost of transmitting power over this 310-mi distance would be about $35 million. Overall charges per kwhr at Pratts Junction would be 7.21 mills minimum and 9.01 mills maximum.

At the request of DPU, the survey also studied the following factors: cost of both a fully relaying transmission delivery and a single circuit transmission to Pratts Jc; steam plant costs; the effect of varied load factors; analysis of a scheme involving power wheeling costs; spinning reserve costs; and a project for obtaining smaller power blocks for delivery in western Massachusetts. These studies showed conclusively that there was no appreciable economic advantage to Massachusetts in obtaining the previously sought-after St. Lawrence power.

The Massachusetts study also explored the possibility of using the facilities of Vermont, which is expecting to receive a 100-Mw block of power from the New York Power Authority. Under this method Vermont facilities would be used to supply a fully relayed block to Pratts Jc, but there would be little economic gain.

From the Airwaves . . .

Soviet Radio reports that Stalingrad's hydroelectric station will be linked with the Donbas industrial area by the world's first 800kv direct-current transmission line. Fifteen local grids, including those of Kirov, Kharkov, Kalinin, and Saratov, will be joined.

Respirators & Blackouts

Cleveland Electric Illuminating Co has set up an emergency, 24-hour, system-wide, life-saving service aimed at restoring power in a hurry when an outage blacks out a polio patient's home, shutting down his respiratory equipment. CEI keeps a residential directory of such patients, showing how long each can be without his type of breathing aid. Crews are dispatched by radio when trouble develops. If needed, one of CEI's strategically located portable generators is rushed to the scene.

Facts & Figures from EEI

Edison Electric Institute's year-end report for 1956 shows the December peak fell short of the predicted 106 million kw by 3 million kw, which it attributes to mild weather. But this 103 million load represented a record high, exceeding the 1955 December peak of 98 million kw by 5%. Power output in '56 ran about 600 billion kwhr, a 10% increase over 1955. New generating capacity totaled over 6.6 million during the year and the industry entered 1957 with 44.8 million kw on order and scheduled for service. This is 34% more than at the beginning of 1956. The 15.6 million kw now scheduled for operation in '58 sets a new record, EEI said. Of all new capacity scheduled, 88% is thermal and 12% hydro. The report also shows that the nation's utilities ordered 17.9 million kw of new generating capacity during 1956.

Changes Here & There

The Municipal Electric & Water Dept. of Winnetka, Ill., (pop. 12,105) is to sell its electrical system to Commonwealth Edison Co for $4 million. Winnetka's village council made the decision following a postal card vote which showed residents favored the move 2,608 to 2,387. This is the last remaining Chicago suburb which operates its own power system, including generation. Woodstock, Ill., about 50 miles northwest of Chicago, now has the nearest generation and distribution system owned by a municipality.

In New York State, residents of Dunkirk (pop. 18,007) voted 3,129 to 2,336 to sell their distribution system valued at $800,000, to Niagara Mohawk Power Corp. After negotiations are completed, NMP will have 7,000 more customers. Six years ago a similar move was defeated by 600 votes.

In Carthage, Tenn., (pop. 1,604) Upper Cumberland Electric Membership Corp announced a 10% reduction in power bills affecting its 16,000 members, as of March 17. Supt Raymond H. Forkner said the cut was ordered because of the "excellent financial health" of the co-op. The co-op is five years ahead of its loan repayments to REA, he said. "This will make our rates the cheapest in the United States," he said.

Of English Taxes . . .

Leslie Gardner, inventor and managing director of Western Deepoil Manufacturers, Ltd., Bristol, Eng., says exploitation of his new solar house-heating scheme is "impossible" because of taxes which Inland Revenue Dept proposes to levy. He said his $28,000, 10-room house could be heated, and cooking power provided, for 28¢ a week. It would cost $7 to do the same job with coal, coke, and electricity, he said. Gardner claims Inland Revenue said he would be taxed on the difference between the two costs.

Inland Revenue, meanwhile, told McGraw-Hill World News that such cases are "entirely confidential." But a spokesman said that there is nothing in the law that provides for taxing ordinary household economies.

Zzzzt—200 Volts

William B. Keller and a companion found a strange looking, disk-shaped fish on the beach of San Diego's Mission Bay recently. It measured 3 ft across, weighed an estimated 50 lb. Keller stepped in close to lasso it. His wet shoe touched it.

Zzzzzt.

Dr Carl Hubbs, Scripps Institution of Oceanography, pronounced the fish an electric ray—which can "work up a charge" of about 200 volts, he said.

Automation in High School

A group of engineers and scientists have proposed that Pittsburgh schools teach automation to increase interest in technology, to induce students to pursue engineering in college, and to train students for technician and junior engineer jobs. A Board of Education committee has approved the plan, and the full board is expected to endorse it later this month.

Radical Device Stops Lightning

PEA T&D group is told of Philadelphia Electric's successful trial of new Cougnard Deionisers for lightning protection

The first experimental installation in America of Cougnard Deionisers for complete protection of an entire transmission line has produced some amazingly effective results. H. N. Ekvall, Philadelphia Electric Co, told Pennsylvania Electric Association's Transmission and Distribution Committee of his company's experience with this device which departs sharply from accepted principles and practice. The T&D group met Jan. 31-Feb. 1 at Harrisburg.

Ekvall readily admitted that further operating experience is needed to demonstrate conclusively the protective value of this new scheme, which resembles grading rings more than any conventional device. Nevertheless, the effectiveness of this type of protection on a Philadelphia Electric 33-kv line cannot be overlooked.

Ekvall attributed a definite improvement in lightning performance of the experimental line to the use of deionisers. During 1951-55 this 16-mile 3-phase wood-pole line was the company's poorest performer in lightning storms. It had 6.8 trippings per year. But in 1956 the line had just a single tripping before and one after the May installation of 81 deionisers. In the same year six of seven other 33-kv lines had as many or more trippings than their five-year average.

The operating principles of the deionisers are virtually unexplainable. The late Jerome Cougnard invented the device in 1946, and "his theoretical explanation is difficult to comprehend in the light of conventional thinking and still remains to be proved or disproved."

Ekvall explained that in deadend and pin-type deionisers one element is grounded and the other energized at line voltage. Capacitance to ground is about 10 micro-microfarads.

The 33-kv deadend-type deioniser is composed of 24-in.-dia parallel galvanized steel discs spaced 9½ in. apart. Each main disc is supported by an intermediate disc connected to an end disc with six adjusting bolts. The bolts are used for paralleling the main discs during installation in the insulator string. The end discs have ball-and-socket hardware fittings of the same length as the insulators, thus permitting direct insertion in the string.

The 33-kv pin-type consists of an inverted U-shaped galvanized steel hood 26-in. long, 13-in. wide, and 10-in. deep. It clamps to the top of a 45-kv pin-type insulator. Two barrier plates extending above the hood are slotted, partially at the bottom, to permit access of the line conductor which is clamped to the top of the hood.

Idaho Co-op Planning Plant on Priest River

Northern Lights, Inc, Sandpoint, Idaho, a cooperative, will start preliminary engineering work and site studies for two dams on Priest River during the spring or summer. Combined cost of the two dams would be about $3 million. Installed capacity would be about 8,000 kw.

Agreement must still be completed with the Idaho reclamation engineer. The co-op will be ready to file for an FPC license by early winter. If granted, construction could begin next year.

Belts Save Backs and Lives

To help reduce back injuries, Indianapolis Power & Light Co has provided its linemen with these "back saver belts." The device, part of the regular safety belt, also prevents men from falling out of their belts after loosening them for special jobs.

FPC Reports 528-Mw Net Capacity Gain

PLANT ADDITIONS DURING NOVEMBER

State	Utility	Plant	Fuel	Capacity
Ill.	Illinois Power Co	Vermilion	S	90,000
Iowa	Whittemore Municipal Light & Power Plant	Whittemore	IC	588
N. M.	Town of Farmington	Old Plant	IC	1,000
Okla.	Public Service Co of Oklahoma	Tulsa	S	170,000
Ore.	California Oregon Power Co	Lemolo #2	H	33,000
Tenn.	Tennessee Valley Authority	Gallatin	S	225,000
Wash.	U. S. Army Engineers	Chief Joseph	H	64,000
	RETIREMENTS			
Iowa	Whittemore Municipal Light & Power Plant	Whittemore	IC	74
Mich.	Consumers Power Co	Hubbardston	H	240
Mich.	Consumers Power Co	Wagar	H	450
Ohio	Columbus & Southern Ohio Electric Co	Floodwood	S	20,000
Tex.	Denton Utilities	Denton	IC	5,245
Tex.	City Public Service Board, San Antonio	Mission Rd	S	28,500
Wash.	Public Utility District #2	Ilivaco	IC	496

U. S.	Hydro	Steam	IC	Total
Added	97,000	485,000	1,588	583,588
Retired	690	48,500	5,815	55,005
Adjustments Plus	.....	.....	873	873
Adjustments Minus	.....	1,500	180	1,680
Net Change	96,310	435,000	3,534	527,776

H—Hydro, S—Steam, IC—Internal Combustion

United States Capacity as of December 1—Hydro, 25,564,075 kw; Steam, 91,943,165 kw; IC, 2,398,664 kw; Total, 119,905,904 kw.

CHAIRMAN W. H. MAPES, Oklahoma Gas & Electric Co, passes gavel to his successor, G. A. Jennings, Kansas City Power & Light Co. Chairmen serve a year

Utility Pushes Electric Heating

Oklahoma G&E reports to MVEA group that 410 sales were made in 16 days. Kansas G&E spurs electric cooking

Living up to its slogan, "Heat Better —Electrically," Oklahoma Gas & Electric Co expects to be adding 25,000 to 30,000 kw of heating load annually by 1960. Sales of electric heating equipment have been so good that some distributors have ordered four times this season. OG&E has even used planes to rush equipment to areas where stocks were exhausted.

This was the optimistic picture, W. B. Scheidt gave the Industrial and Commercial Sales Conference of the Missouri Valley Electric Association. The group met Jan. 31-Feb. 1, at Kansas City.

In a campaign started in January, with reports in on only 16 days, calls had been made on 1,090 customers, Scheidt reported. There were 410 sales closed for 767 heating units with a total capacity of 1,067 kw. Estimated annual kilowatt hour sales were 700,093 and EAR, $14,654.

Scheidt said electric utilities must take the lead in selling electric heating and that they must sell advantages not operating costs. OG&E is adding 40,000 to 50,000 kw of cooling load a year. It is going after heating to balance air conditioning.

Heat pumps can be designed for any climate, declared Vern Hagmann, General Electric Co. But for severe climatic conditions equipment costs would be too great. Resistance heating elements are added for the few hours a year in which they are needed.

Hard selling of commercial electric cooking has brought results for Kansas Gas & Electric Co, asserted C. B. Weeks. Sell advantages and net profits to restaurant operators. One told Weeks, "Sure my electric bill is high. But I wish it were $100 more a month because that would mean I was making more money."

Hot trial demonstrations and a modern demonstration kitchen have been two of their more effective sales tools.

When it became apparent that apartment building wiring in Kansas City was becoming badly overloaded, Kansas City P&L and the city electrical inspector worked out a solution, Marshall A. Havenhill of the utility reported.

Tenants were adding equipment, particularly air conditioning, and wiring it from the apartment to the service entrance switch. A single meter and entrance switch served each building. Such connections resulted in fire hazards and poor service.

The solution was to permit building owners to change from one meter and one switch, with the landlord paying the electric bill, to individual meters and switches for the tenants, with them paying the bills. Tenants received better service, the company got more revenue, the owner saved the cost of the electricity, and the city gained by eliminating fire hazards.

In all 162 buildings with 2,600 meters have been converted at a cost of $200,000.

See Better, Work Better

Where they can see better, they can work better, E. A. Linsday, GE, said in talking on industrial lighting. Today there is not so much difference between the well-lighted office and the well-lighted plant.

In selling commercial lighting, Richard G. Slauer, Sylvania Electric Products, Inc, urged the group not to sell lamps and fixtures but to sell diffused light, light on the product, and the ability of light to sell merchandise. He said the luminous ceiling probably offers the best opportunity to push lighting levels upward.

Legion Lighting Effective

H. E. Ryerson, Iowa-Illinois Gas & Electric Co, described the lighting in the main auditorium of the American Legion Building in Moline, Ill. Lighting intensity is 40 ft-c with a total of 16,000w or 3.55 w per sq ft. Colored lights, red, green, blue, totaling 3,000w, add to the effectiveness.

Induction heating, said Glenn Williams, Allis-Chalmers Manufacturing Co, improves the product, reduces rejects, and cuts costs.

In giving some "Do's and Don'ts" of customer relations, J. T. Jones, Empire District Electric Co, said that "when the chips are down, it is only customer relations that will add up to public relations that will keep free enterprise power the first choice of our customers."

G. A. Jennings, Kansas City P&L, was elected chairman of the group. Succeeding him as vice chairman is S. L. Paul, Missouri Edison Co. The term of office is one year.

Delinquent Account Procedure for Residentials

		BEFORE		AFTER
		Prompt Payers	Slow Payers	All Customers
MARCH	1			
	2			
	3			
	4	Billed	Billed	Billed
APRIL	1			
	2			
	3			
	4		Reminder Notice	
MAY	1		Final Notice	
	2		Collection Order	
	3			
	4	Reminder Notice		Reminder Notice
JUNE	1	Final Notice		
	2	Collection Order		
	3			
	4			Final Notice
JULY	1			Collection Order
	2			

Cost-Cutting "After" Mailings . . .

Plus Office Handling Aids . . .

Revamped Collection Practices

CARL E. BROCKWAY, Manager, Methods Department, Potomac Electric Power Co, Washington, D. C.

New policies and procedures have been established by Potomac Electric Power Co for delinquent bill collections. The system gives customers more time to pay and reduces costs for processing delinquent accounts by $15,000 yearly. Most of this reduction results from use of reminder and final notice stickers affixed to bills, rather than notices mailed separately. Other savings were organization and equipment changes that released three clerks for other work. The change resulted from a complete study of old practices.

$7 Arrears Was Dividing Line

A bill is supposed to be paid within 20 days after rendition. When it isn't, the account is considered delinquent and subject to a 10% additional schedule charge. Notices of arrears under the old procedure were only sent for residential accounts in arrears $7 or more.

The old practices were analyzed in terms of code records kept on individual customers' paying habits, showing the number of final notices, collection action, and disconnections. Maintenance of these records to speed poor-paying customer collections was nullified, in most cases, by the $7 minimum. Customer paying habit records were accordingly discontinued, except records of disconnections and bad checks.

Six-Part Form Eliminated

Next the delinquent notice was considered. Previously, a six-part, one-time carbon form was used. These parts were a reminder notice with cashier's coupon, final notice with cashier's coupon, collector's work copy, and office record copy. By eliminating this form and sending notices with bills considerable savings could be realized. But including delinquent notices with bills allowed customers three additional weeks, thereby further increasing the delinquent amount.

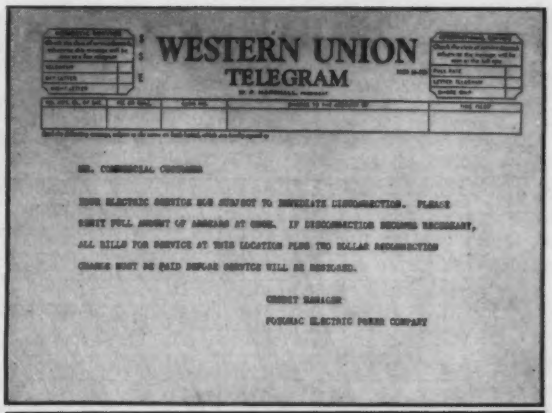
Past records revealed only 2% of the accounts disconnected were not reconnected. By applying a dollar equivalent of three weeks' additional service to the 2%, added costs were estimated to be only $2,000 yearly. This more than justified elimination of the six-part form.

Stickers Insure Reading

The new delinquent notice is a sticker, which is attached to the bill. On the back of the sticker is a pressure-sensitive adhesive substance. Stickers are dispensed from two machines—one for reminders, another for final notices. This type of notice was selected because its red ink attracts attention and it cannot be left in the envelope unread.

Comparison of old and new practices in the accompanying illustration shows additional time for payments. Reminder notices are now sent regardless of amount, ignoring the $7 minimum rule. However, this rule does apply to final notices because non-payment of these accounts subjects them to disconnection action. The minimum is set to prevent high cost in collecting small amounts.

Sticker Notice Machines and . . .

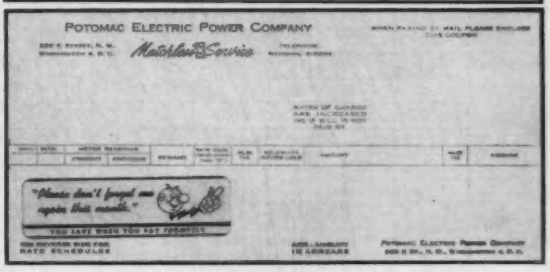


WESTERN UNION
TELEGRAM

MR. COMMERCIAL CUSTOMER

YOUR ELECTRIC SERVICE HAS BEEN SET TO BE DISCONNECTED. PLEASE SENDIT FULL AMOUNT OF ARREARS AT ONCE. IF DISCONNECTION BECOMES NECESSARY, ALL BILLS FOR SERVICE AT THIS LOCATION PLUS TEN DOLLAR RECONNECTION CHARGE MUST BE PAID BEFORE SERVICE WILL BE RESTORED.

CREDIT MANAGER
POTOMAC ELECTRIC POWER COMPANY



POTOMAC ELECTRIC POWER COMPANY

Matchless Service

"Please don't forget me again this month."

YOU SAVE WHEN YOU PAY PROMPTLY

Wires, Reminders Help as . . .

Save More Than $15,000 Yearly

In a commercial customers' table like the one shown, this schedule would now be followed: **1.** Customer is billed fourth week in March. **2.** Reminder is mailed at April's end. **3.** Final notice is sent at end of May. **4.** Collection order is written the first week of June.

Organization Changes Made

The new procedure for handling notices required organizational changes. Formerly the customer accounts department prepared six-part, reminder-final notice forms and turned them over to the credit department for mailing and follow-up. The credit department had to telephone customer accounts department if more basic information was needed. And main switchboard operators had trouble directing customers' calls to the proper department employee.

Now, a special customer accounts group handling delinquent accounts takes telephone inquiries regarding accounts, affixes both reminder and final notices, and sends a collection order to the credit department. A code record of these steps kept on customers' ledgers provides a complete record of the status of accounts. Special telephone facilities were set up for this group so that most bill inquiries are answered at this station.

Liberalization of collection procedures resulted in a sterner attitude towards partial payments. An analysis indicated customers were aware of the $7 minimum and would pay only enough to reduce the bill to or below this minimum to avoid disconnection. When collectors were involved, the procedure amounted to a monthly door-to-door collection service. Now, in most cases, partial payments do not stop disconnections.

Big Savings Plus Three Clerks

Many savings have been made under the change. In addition to an annual reduction of over $15,000 for mailing, the procedure saves on coding of billing records to indicate paying habits, preparing notices, handling notices, screening notices by supervisors, checking for payments, posting of paying habits to customer history records, and biennial review of this history. Final notices and collection orders have been cut almost 50%, without much increase in the number or amount of arrears. And three company clerks were released for other duties.

Telegrams Pay Off

Telegrams with a standard message prove useful in collecting from commercial customers with arrears of $15 or more. Western Union is given names and addresses of delinquent accounts. The next morning the customer is handed the telegram—not telephoned. If these bills are not paid in three days, the collector either collects or cuts off. Of course, there are always going to be exceptions.

Telegram costs are difficult to compare with those for a collector's call because of various factors that make up a call. But PEPCO's credit manager believes that another collector would be required to accomplish the telegram results.

What Is an Industrial Customer

Fig. 1 — Justified Investment vs Demand and Annual Consumption, 69-kv Supply

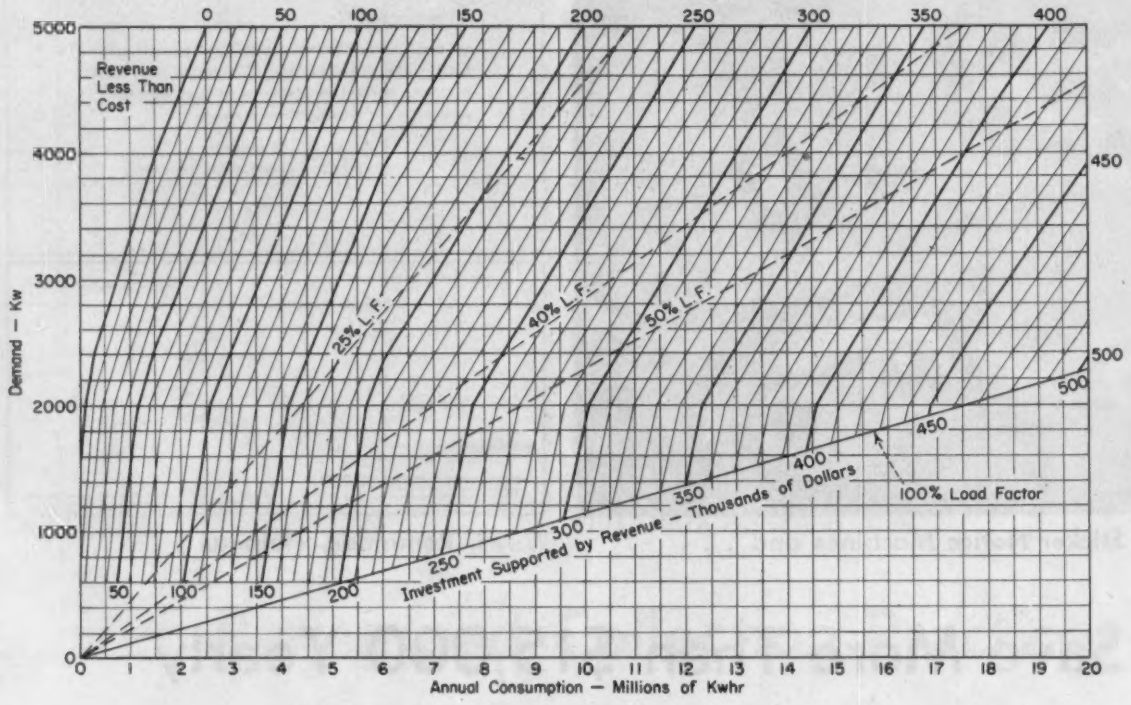
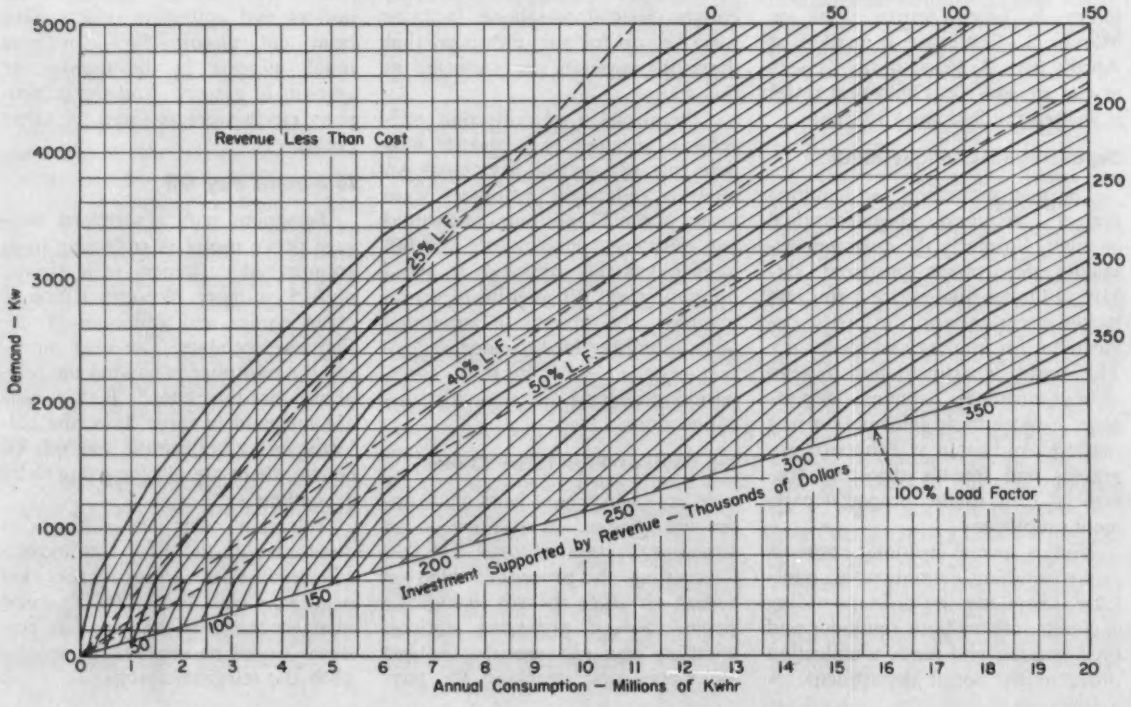


Fig. 2 — Justified Investment vs Demand and Annual Consumption, 34.5-kv Supply (Larger Customers)



Worth?

Load factor, maximum demand, supply voltage, all affect decision; rule-of-thumb estimates may dilute revenues

HANS E. NISSEL, Consulting Engineer, Old Greenwich, Conn.

A graphical method can be used by an electric utility to determine at a glance how much investment for special service facilities a large industrial customer warrants on the basis of his maximum demand, annual consumption and supply voltage. Samples of such charts for 12, 34.5 and 69-kv supply voltages are included in this article.

In determining what may be spent on substation equipment, spur lines, and reinforcement of distribution facilities, many companies oversimplify by using a "rule-of-thumb", e.g., three times the estimated annual revenue.

As only revenue in excess of cost of service is available for supporting such investment, a rule based on revenue alone and ignoring cost of service can yield proper results only by chance. Three principal factors must be considered for a particular customer: Load factor; maximum demand, and supply voltage.

With the two-part rates used by most utilities for such customers, the demand charge generally is below and the commodity charge above the actual cost of service. Consequently, for a given amount of revenue, the investment justified increases substantially with the load factor.

Furthermore, these rates usually incorporate a block feature which reduces the revenue per kw and per kwhr as demand and consumption increase. As this trend is not generally accompanied by a reduction in unit cost, the investment justified by revenue is less for large customers than for small ones.

Charts Investment Guide

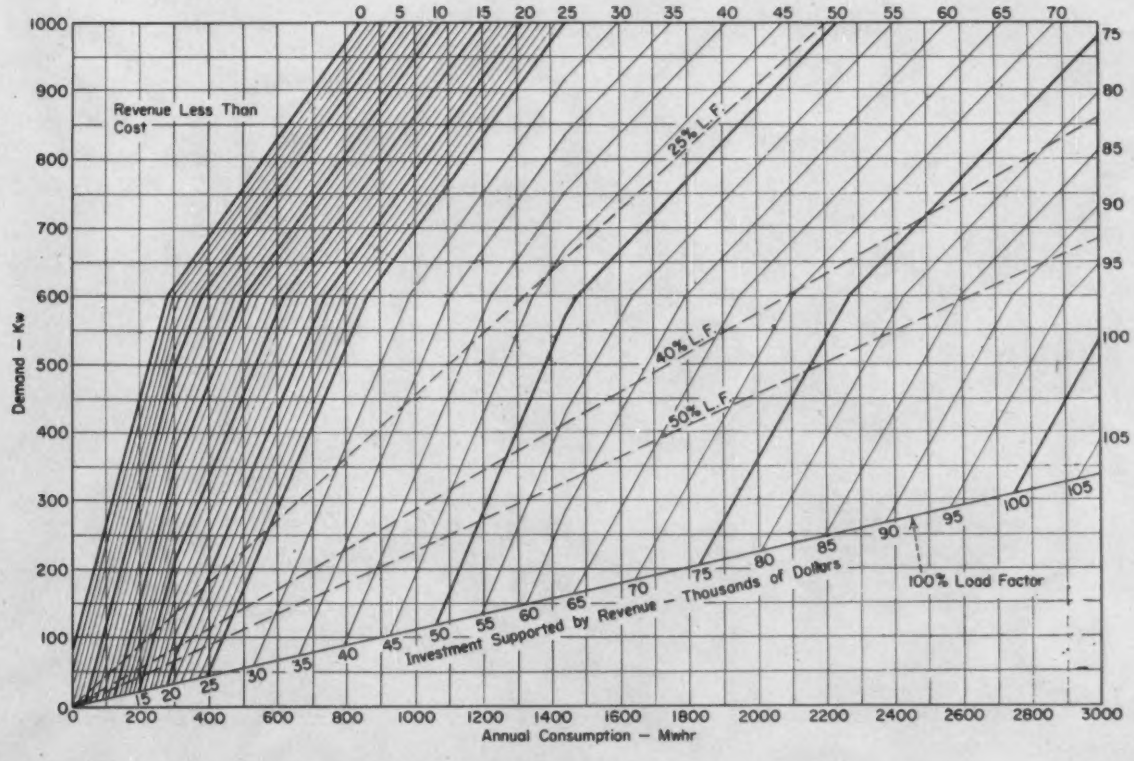
Finally, because of the cost of the additional facilities required at lower voltage, the margin of revenue over cost of service, and hence the investment justified, generally increases with the supply voltage.

Thus where two-part block rates are used, the investment supported by a given revenue increases with load factor and supply voltage and decreases with maximum demand. As only revenue in excess of cost is available for supporting such investment, a cost analysis is a prerequisite for any applicable formula. Where two or more supply voltages are in use, the analysis must determine the cost of service at each for the class of customer concerned.

To provide a tool for a quick estimate of the investment justified the author has designed for a client four charts, reproduced here, showing the amount supported at supply voltages of 69, 34.5 and 12 kv, as a function of annual consumption and maximum demand.

Capacity and commodity costs in serving industrial customers at these voltages were derived from an analysis undertaken to provide guidance in rate design. It determined the

Fig. 3 — Justified Investment vs Demand and Annual Consumption, 34.5-kv Supply (Smaller Customers)



cost of serving urban residential, rural residential and farm, commercial, municipal, REA, and industrial customers. For residential customers further details were provided for towns of different size and customers having different annual consumption. For the industrial class, cost of service was established for small and large customers and for the three voltages.

The unit costs shown represent the average cost of service to industrial customers at any point in the three voltage systems. They comprise carrying charges, operating expenses, and a proportionate share of administrative and general expenses but not costs related to customers' substation, metering equipment, and spur lines.

Supply Voltage kv	Capacity Cost per Year $ per Kw	Commodity Cost ¢ per Kwhr
69	24.50	0.33
34.5	31.50	0.35
12	39.75	0.37

The higher capacity cost at 12 and 34.5 kv is due primarily to charges for additional equipment for operation at these voltages, and the higher commodity cost is a consequence of increased energy losses.

By contrast, the rate actually in effect is a two-part block rate, identical for the three supply voltages, with a monthly demand charge totaling $26.40 to $19.80 per kv per year and a commodity charge of 1.3¢ to 0.6¢ per kwhr, depending on maximum demand and consumption. Except for a few customers large enough to justify a 69-kv supply, the first block of the demand charge is below capacity cost; the second block is substantially below cost at all voltages. The commodity charge, on the other hand, is two to four times as great as commodity cost. This dependence on commodity sales to compensate for the deficit created by the low demand charge accounts for the effect of load factor.

Assume No Seasonal Variation

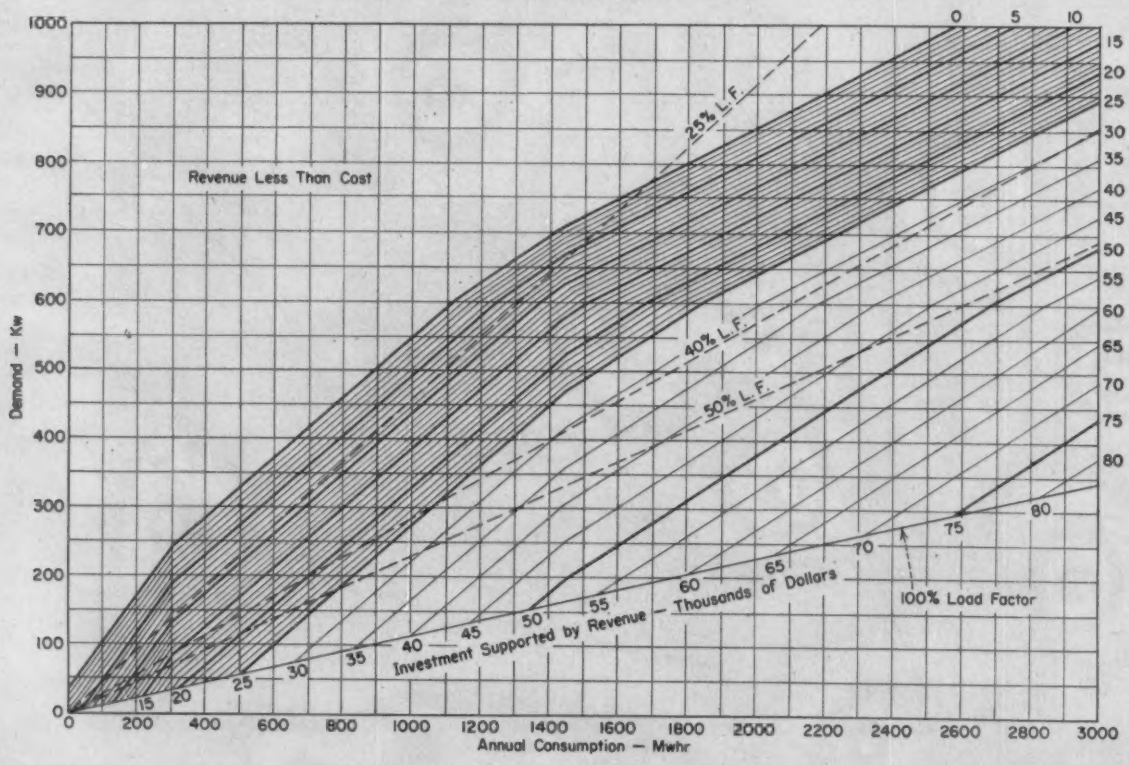
Two charts show supported investment vs demand and annual consumption up to a maximum of 5,000 kw with supply voltages of 69 and 34.5 kv, respectively. Two additional charts show a similar plot up to a maximum of 1,000 kw for supply voltages of 34.5 and 12 kv, respectively. The 12-kv plot was not carried beyond 1,000 kw because it is generally more economical to supply larger customers at 34.5 or 69 kv. On the other hand, the relatively high cost of substation plant for 34.5 and 69 kv does not warrant supplying small customers at a voltage exceeding 12 kv.

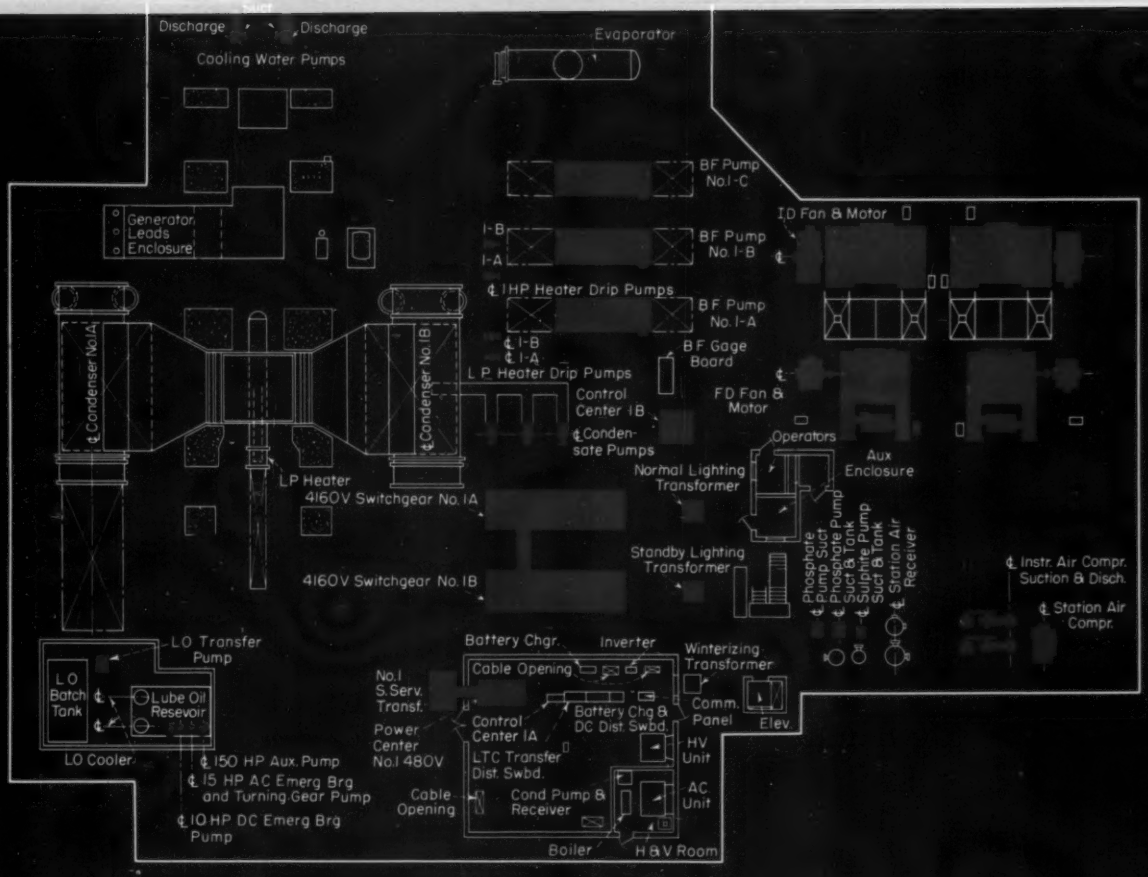
Each chart is based on the excess of revenue over cost of service at a particular voltage. This excess is capitalized at the rate of 14.5%, allowing for return, depreciation accrual, ad valorem and income taxes, and operation and maintenance expenses. The charts assume no variation in demand from month to month, assuring maximum revenue for a given maximum demand. When seasonal fluctuations exist, compensating adjustments must be made.

The charts prove that there is no direct relationship between revenue and justified investment for serving a customer. Although local conditions must be given proper consideration, the charts indicate that there is generally a most economical

(*Continued on page* 154)

Fig. 4 — Justified Investment vs Demand and Annual Consumption, 12-kv Supply





Big-Unit Auxiliary Problems Met

JOHN J. KEARNEY, Assistant Managing Technical Editor

BF Pumps Alter Auxiliary Systems

Some power plants will have non-electric drives for large BF pumps. But all-electric auxiliaries are still possible even for large size units.....p 78

Net Send-Out Analysis Is Valuable

Reduces possibility of discrepancies in determining type of boiler feed pump drive for large units and minimizes use of incremental cost figures.....p 81

Automatic Transfer Is Unnecessary

Elimination of transfer schemes will enhance simplicity of design and will minimize the cost of auxiliary power systems for very large units.....p 84

Shaft-Driven BF Pumps Cut Costs

Attachment to shaft extension of cross-compound turbine-generators saves about $500,000 on auxiliary power systems at the new Bergen power plant..p 86

River Rouge Design Conventional

Studies show motor-driven BF pumps, constant speed ID and FD fans with vane control, and 4-kv auxiliary voltage most suited to new 320-Mw unit.....p 88

Proven System Used on 335-Mw Machine

Unit substation type load-centers are supplied at 13.8 kv. They are located wherever load occurs. The large unit size imposes some changes.....p 90

BF Pumps Alter Auxiliary System

Increased power requirements complicate designs. But all-electric auxiliaries are still possible for very large units

W. H. BORGHESANI, Electrical Engineer,
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Designing auxiliary power systems for large steam turbine-generator plants is complicated by the increased power requirements of the boiler feed pumps.

For units ranging from 100 to 275 Mw and with 2,400-psi steam pressure and above, consideration must be given to other than motor drives for boiler feed pumps. For 3,500 psi and above, pump speeds from 6,000 to 9,000 rpm, and turbine-direct drives or tandem-motor drives with step-up gear and hydraulic couplings are used. Main turbine-generator shaft-drives from cross-compound units might be used, particularly with 3,600-rpm pumps.

The type drive finally selected has an important bearing on the design of the auxiliary power system. For example use of variable speed couplings for fans or pumps is beneficial from an electrical standpoint as it reduces starting amperage of the drive motor. Although hydraulic and magnetic coupling installations consume more power than a constant-speed installation at full load, there is an overall saving for units operating at variable loads. For boiler feed pumps the difference in pressure required to feed the boiler at a given load and the pressure generated by the pump at constant speed must be absorbed by throttling or eliminated by variable speed operation. In general, magnetic drives are suitable up to 1,800-rpm and hydraulic couplings up to 3,600-rpm motor speeds.

Fig 1—Boiler Feed Pumps Increase in Size as Units Get Bigger and Steam Pressures Get Higher

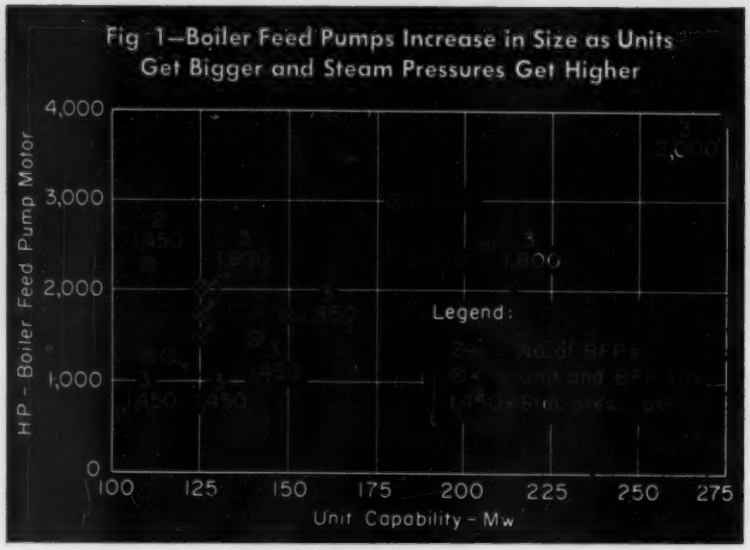
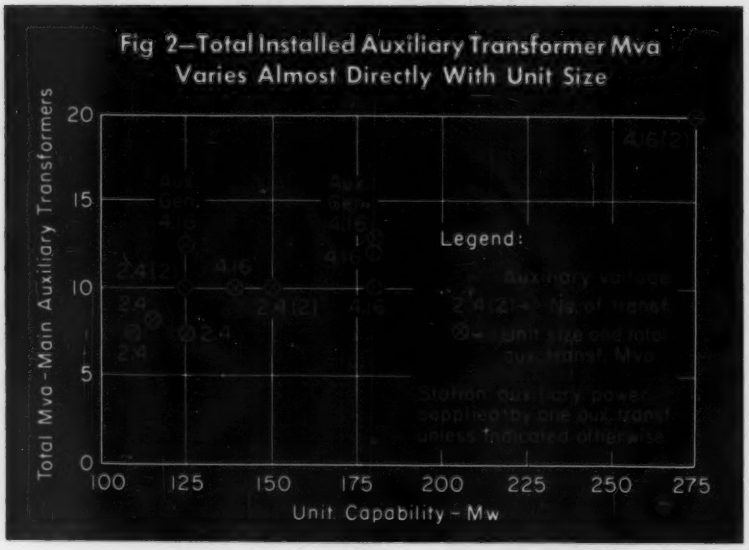


Fig 2—Total Installed Auxiliary Transformer Mva Varies Almost Directly With Unit Size



Pump Needed for Startup

Selection of turbine or direct shaft-driven pumps, however, does not completely relieve the electrical system of boiler feed pump power requirements; a motor-driven pump is required for startup. The size of this start-up pump may vary from a minimum to build up enough pressure so that the turbine-driven pumps can take over, to one of high enough capacity for a "once-through" type boiler where full pressure must be developed before admission to the main turbine.

For steam pressures 1,450 to 2,400 psi and unit capabilities ranging from 112 to 275 Mw maximum, size of auxiliary motor drives varies from 1,250 to 4,000 hp, as shown in Fig. 1 for several installations made or being made by Stone & Webster Engr Corp. Fig 2 shows that for these same units 2,400-v systems are in general use for units up to 125 Mw, and 4,160 v for units above 125 Mw.

When voltages above 4,160 v are considered because of motor sizes above 5,000 hp, the greater cost per motor horsepower and per switchgear unit should be carefully evaluated.

For large, very high-pressure units

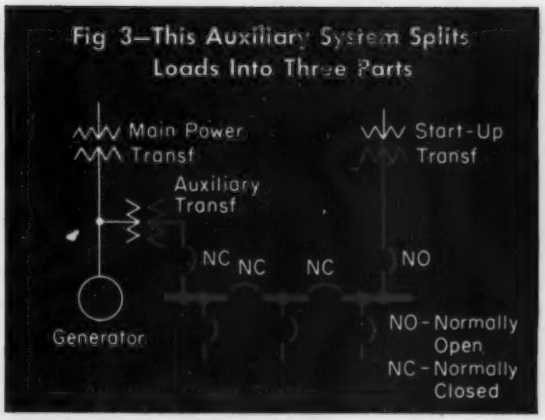


Fig 3—This Auxiliary System Splits Loads Into Three Parts

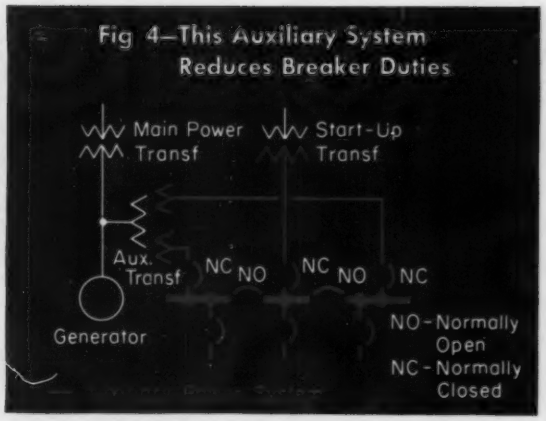


Fig 4—This Auxiliary System Reduces Breaker Duties

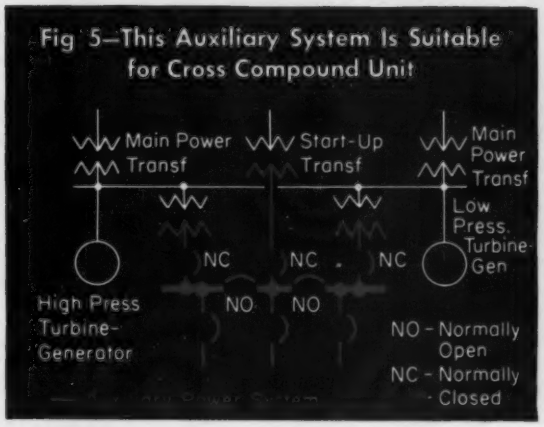


Fig 5—This Auxiliary System Is Suitable for Cross Compound Unit

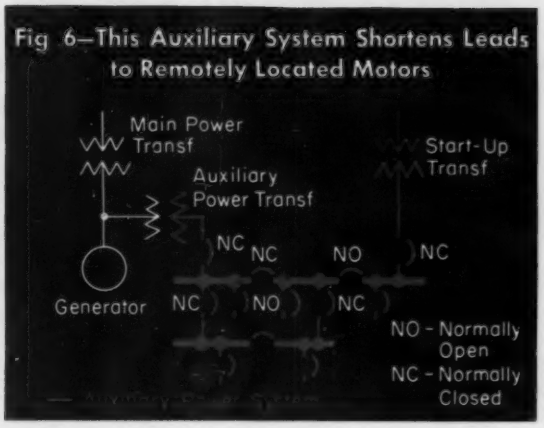


Fig 6—This Auxiliary System Shortens Leads to Remotely Located Motors

using turbine or main shaft-driven boiler feed pumps, it may be possible to use a 2,400-v system, provided adequate voltage can be maintained in starting the larger motors and the momentary duty is kept below 60,000 amp for a fault on the load side of any 2,400-v feeder. If motor-driven pumps only are to be considered, two motors per pump might be used when each of two motors is supplied from separate buses.

When voltage higher than 4,160 v is required, these motors could be supplied directly from the main generator leads through a series reactor, the remainder of the auxiliary load being supplied at a lower voltage. Another scheme uses a double-secondary auxiliary transformer.

Fig 2 also shows the number and total kva rating of the auxiliary transformers and auxiliary generators for the various size units. It is interesting to note that total installed auxiliary transformer kva varies almost directly with unit kw capability.

For 100 to 275-Mw units, one voltage—either 2,300 or 4,160—in general, should be suitable for the large auxiliaries, and 440 v for motors up to 100 or 150 hp.

Could Carry Less

Fig 3 shows three bus sections, one normally supplied from the start-up or reserve transformer, to which one of three motors for similar auxiliaries could be connected. Two bus sections are sometimes used for three similar auxiliaries and two, three, or four bus sections for two similar auxiliaries.

For greater total amperage or to reduce interrupting or momentary breaker duties, each normal bus section could be supplied from one of two auxiliary transformers secondaries as in Fig 4. For a cross-compound unit, Fig 5 could apply. For Figs 4 and 5 the start-up supply would probably carry less than full-load requirement continuously. Where motors are remote from any one of several switchgear locations, it is sometimes economical to install two sets of switchgear, as in Fig 6, to shorten the leads.

Auxiliary transformers rating depends on the turbine generator size, type of fuel, circulating-water system, steam condition, and type of boiler feed pump drive. When transformer kva sizes required for the auxiliary and reserve or start-up supplied have been determined, the next step is selection of transformer impedances, auxiliary voltage, and bus arrangement.

Impedances Kept Down

Transformer impedances should be kept to a minimum to prevent large voltage dips during starting of larger boiler feed pump and boiler fan motors. Motor driven exciter sets, which may have locked-rotor currents of 1,500% of full-load current must be considered.

Choice of switchgear may be dictated by main supply breakers to obtain required current, interrupting, or momentary ratings. Current rating required would vary with type of fuel.

A typical station service one-line diagram for two units, each having a capability of 250 Mw, is shown in Fig. 7. Assume motor-driven auxiliaries, gas or oil fuel, steam conditions of 2,400 psi, 1,050F initial and 1,000F reheat, and 90F circulating water system for the station.

Based on 4,160 v and assuming 400% minimum induction-motor contribution from the auxiliaries with 18,000 hp connected during a 3-phase fault on one feeder circuit, the 3-phase symmetrical fault contribution from the motors could be approximately 15,000 amp momentary. On the basis of 10% impedance for a 15,000-kva auxiliary transformer, the total fault contribution from the transformer and motors would be 150,000 kva for interrupting duty and 46,000 amp for a momentary duty.

Breakers Indicated

Based on these values, circuit breakers with a 60,000-amp momentary rating should be used. If 2,400-v level is selected, the auxiliary transformer secondary breaker current would have to be at least 3,600 amp. A breaker with this current rating is not available. At 4,160 v, the secondary breaker could be used with a current rating of 2,000 amp.

Reserve transformer secondary breaker should be rated 3,000 amp if this transformer is rated 15,000/20,000 kva. When installing the first unit of a new plant, provision is sometimes made for fans to increase reserve transformer capacity. When a second main unit is added, capacity will be sufficient to supply one unit at full load and to start the second.

Varies with Voltage

The next step is determination of whether reduced-voltage starting is required for boiler feed pump motors in the order of 4,000 hp. Assuming 24,000-kva starting demand, starting voltage would be about 86% and starting torque approximately 75% of normal. Motors with 75% or less full-load starting torque would be satisfactory for across-the-line starting when motor-accelerating torque is adequate.

For specific installations, these general considerations may be modified by the arrangement and choice of breakers and starters. Whether a selective, cascade, or a full-rated breaker system is chosen, the breaker ratings required depend on the short-circuit amperage. This current varies with voltage and can be controlled within practical limits by transformer impedance and other current-limiting means.

For reliability of supply, two transformers, each of full-load capacity, are usually installed. The bus is normally sectionalized, especially when there are duplicate essential auxiliaries. To reduce fault amperage, the transformers are not operated in parallel. For one unit, the bus sectionalizing breaker is normally open so that approximately half load is carried by each transformer for minimum loss. If two units are involved, the second transformer could be a start-up supply for either unit, normally carrying less than half load.

Current-limiting fuses and breakers of reduced interrupting ratings are money savers but the risk of motor overheating due to single phasing must be considered. Combined fuses and breakers are available in which the breaker opens all three phases after a fuse clears.

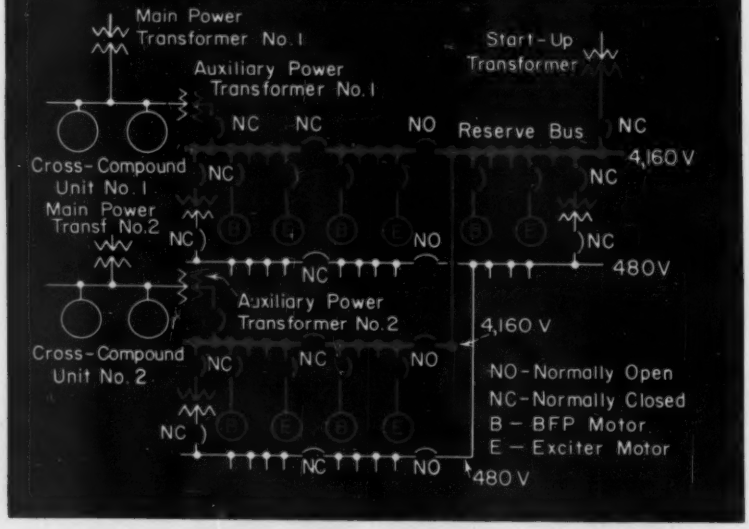
Controls Considered

Where a group of motors is to be served, the extent of local control and interlocking or sequential operation have a bearing on whether control centers or local control are indicated. Appearance, space requirement, and extent of outage due to trouble or maintenance are other important factors.

Referring again to 250-Mw units in Fig 7, two 480-v unit substations could be used, one for Unit 1 consisting of two 1,500-kva transformers with three bus sections. One transformer would be connected to a 4,160-v unit bus; the other to the 4,160-v reserve bus. The other 480-v unit substation for Unit 2 would consist of a 1,500-kva transformer and two bus sections, one connected to the 480-v reserve bus. All motors 100 hp and larger should be controlled individually by electrically operated withdrawal-type circuit breakers. Motors smaller than 100 hp should be controlled from contactor groups or motor-control centers fed from manually operated switchgear circuit breakers.

For the 480-v motor and feeder supply breakers, 600-amp frames appear to be adequate for current-carrying capacity.

Fig 7—Auxiliary System for Two 250-Mw Cross-Compound Units



RESERVE BUS supplies start-up and emergency power for both units. Auxiliary buses are so arranged that no more than one feed pump motor is on each bus

Economic Study on Various Types of Boiler Feed Pump Drives

Net Send-out for Each Scheme — 312,000 Kw
(For 3,600 rpm pump units)

Scheme	Base	Alternate 1	Alternate 2	Alternate 3
Arrangement	Three Motor Driven Half-size Boiler Feed Pumps	Three Turbine Driven Half-size Boiler Feed Pumps plus Startup Pump	Two Turbine Driven Full-size Boiler Feed Pumps plus Startup Pump	One Shaft Driven Full-size Boiler Feed Pump plus Two Motor Driven Half-size Boiler Feed Pumps
Differential main turbine cost	Base	(—)$ 80,000	(—)$ 80,000	(+)$ 52,000
Differential generator cost	Base	(—)$ 55,000	(—)$ 55,000	(—)$ 55,000
Differential electrical costs	Base	(—)$ 82,000	(—)$ 82,000	(—)$ 22,000
Pump costs				
half-size	(+)$204,000	(+)$204,000	—	(+)$136,000
full-size	—	—	(+)$200,000	(+)$100,000
startup	—	(+)$ 12,000	(+)$ 12,000	—
Fluid coupling costs	(+)$ 90,000	—	—	(+)$160,000
Motor costs	(+)$225,000	(+)$ 12,000	(+)$ 12,000	(+)$150,000
Turbine (BF Pump) costs	—	(+)$600,000	(+)$596,000	—
Differential erection cost	Base	(+)$ 6,000	Base	(+)$ 2,000
Differential piping cost	Base	(+)$ 91,000	(+)$ 76,000	(+)$ 24,000
Differential instrument cost	Base	(+)$ 10,000	(+)$ 10,000	Base
Differential cost to operate turbine drives from control room (incl. M.O. drain valves, etc.)	Base	(+)$ 30,000	(+)$ 22,000	Base
Differential cost to operate boiler feed pumps from control room	Base	Base	(—)$ 5,000	Base
Differential foundation costs	Base	Base	(—)$ 1,000	(+)$ 15,000
Totals	**$519,000**	**$748,000**	**$705,000**	**$562,000**
Total Differential Plant Costs (Above Base)	Base	$229,000	$186,000	$ 43,000(*)

(*) This figure does not include extra generator capacity required to provide equivalent capability when shaft driven feed pump is out of service.
An additional $55,000 would be required (or a total plant cost of $98,000 more than the motor drive scheme) if this capacity is desired.

Net Send-Out Analysis Is Valuable

Comparing BF pump drive schemes with this method shows motor-driven pumps are economical for 325-Mw reheat unit

R. F. SCHEIBEL, Mechanical Engineer, Sargent & Lundy, Consulting Engineers, Chicago, Illinois

The "equivalent net send-out" analysis reduces the discrepancies in other methods of determining type of boiler feed pump drive for large units. It is simple and minimizes the use of incremental cost figures. This method requires that boiler capacity and power leaving the main power transformer be the same in both the turbine and motor-driven pump schemes. Most of the plant is unaffected.

For this analysis, extra equipment and capacity are needed only for handling the motor-driven boiler feed pumps. The results of a typical study are shown in the table above. Simplifying features are:

1. Cost per incremental kw generating capacity and most other incremental charge figures do not enter it.

2. Boilers and their auxiliaries and coal handling facilities have the same capacities in both turbine and motor-driven feed studies. This follows because the heat rates are

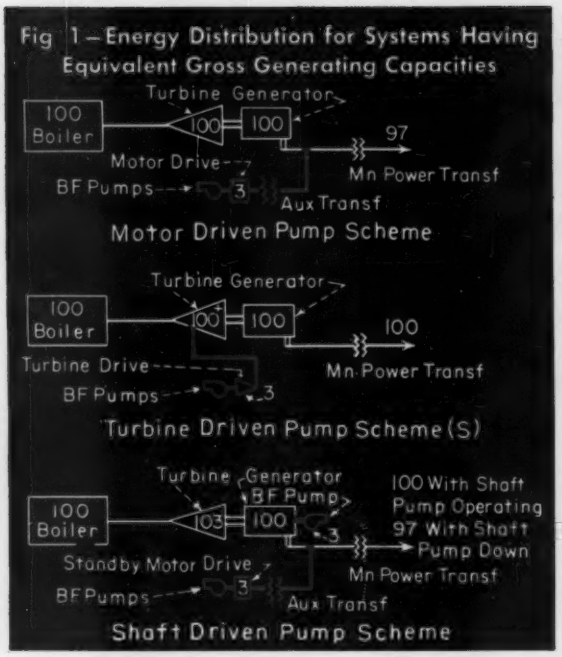


FIG 1—COMPARING SCHEMES on equal gross generating capacity basis takes extensive incremental cost estimating

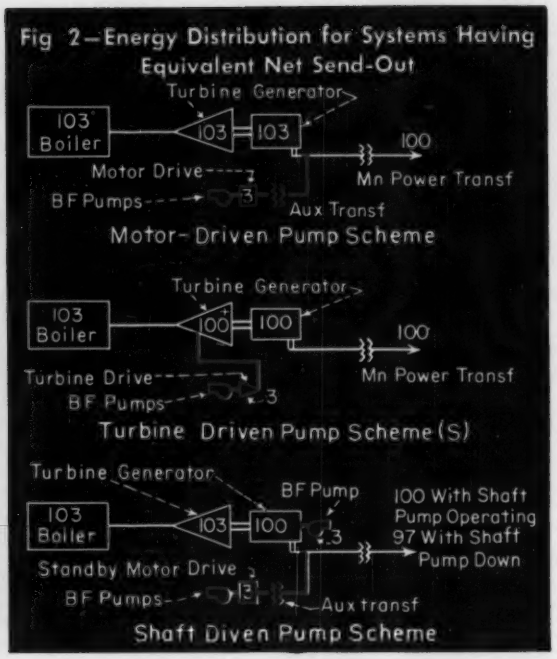


FIG 2—EQUIVALENT SEND-OUT method cuts incremental cost estimating to a minimum when comparing feed pump schemes

substantially the same in both cases. Structurally, the boiler rooms are the same size.

3. Make-up system capacities in both cases are identical.

4. Condensers and their auxiliaries, together with the feedwater heaters, are the same size because the feed and extraction quantities are substantially equivalent.

5. Same capacity main power transformers and transmission facilities would be used for all comparisons.

This approach has been used on large reheat plants up to 325-Mw capacity with throttle conditions around 2,000 psig/1,050F/1,000F. Motor-driven pumps prove to be more economical for a unit of this size.

Reliability and overall economics are of prime importance in selection of boiler feed pump drives. Reliability can be determined only through field experience. But boiler feed pumps and drives are very reliable and are becoming more so as designs are improved. Mal-operations, such as neglecting to open the suction valve, can cause considerable damage to a pump.

Therefore, the basis of comparison is that of having full-load availability with one pumping unit down and, in addition, a start-up pump where required with the steam-driven arrangements. On this basis, these schemes were considered to be equivalent in reliability:

Base: Three motor-driven, half-size boiler feed pumps with hydraulic couplings.

Alternate 1: Three turbine-driven, half-size boiler feed pumps plus small motor-driven start-up pump.

Alternate 2: Two turbine-driven, full-size boiler feed pumps plus small motor-driven start-up pump.

Alternate 3: One generator shaft-driven, full-size boiler feed pump plus two motor-driven, half-size pumps, all with hydraulic couplings.

All Schemes Not Practical

A combination of two turbine-driven, half-size plus one motor-driven, half-size boiler feed pumps is not practical; full-load extraction demand cannot be maintained by one half-size turbine drive when the other is down, unless conventional extraction facilities are provided from the main turbine. A possible combination with two motor-driven, full-size boiler feed pumps is not economical for very large installations. The mechanical saving is more than consumed by the extra electrical expenditures for the unusual motor sizes (10,000 hp each for 325-Mw plant.)

The diagrams for units of equivalent gross generating capacities, Fig 1, show that the turbine-drive scheme requires a larger boiler and main transformer than the motor-drive scheme. Such an incremental increase in boiler capacity will increase proportionally the boiler auxiliaries, condensing equipment and auxiliaries, coal handling equipment, feedwater heaters, cycle piping, building structures, and transmission lines leaving the station, and other related equipment.

These items would result in charges against the turbine-driven boiler feed pump arrangements. Main capital expenditure in the motor-drive scheme which would exceed its counterpart in the turbine drive scheme, would be for auxiliary power transformer and switchgear capacity.

Because power produced for revenues with motor-driven pumps is reduced by the feed pump motor power use, the product of the "cost

per incremental kw generating capacity" multiplied by the kw used by the feed pump motors would be chargeable against the motor-driven pumps. Although this figure is large, because of a high incremental rate of from $100 to $150 per kw, it is more than counteracted by a correctly derived summation of incremental charges plus other costs applicable against the steam drive for machine sizes considerably.

Basically, when "cost per incremental kw generating capacity" is used, it is inferred that it represents actual cost per kw to install, or remove, a certain small amount of power with all parts of the plant proportionately affected by the increment. Actually, such figures are not always realistic, as certain parts of the plant are not equally affected. It is therefore desirable to avoid use of incremental cost figures because of difficulty in obtaining accurate data and estimates.

But the "equivalent net send-out" analysis minimizes incremental cost factors. It resolves itself into charging the motor-driven feed study with extra turbine-generator capacity and extra auxiliary power transformer and switchgear capacity to handle the power use of the boiler feed pump motors. Chargeable against the turbine feed pump scheme would be extra costs for boiler feed pump turbines, piping, valves, instruments, controls, and installation, together with a small start-up pump and associated incremental auxiliary power transformer and switchgear requirements. Fig 2 shows the energy distribution for systems under consideration that have equivalent net send-out.

Functions Clearly Defined

In the net send-out approach all functions are more clearly defined. A typical analysis for 3,600-rpm pumps is given in Table 1. It shows that all three steam-driven boiler feed pump alternates require expenditures exceeding those for an arrangement of three half-size motor-driven feed pumps.

The $52,000 for the main turbine under the shaft-driven pump scheme is for stiffening the shaft and adding a "break-away" coupling between generator and pump. The shaft-driven pump scheme should be charged with $55,000 for additional generator capacity equal to the power demand of the two motor-driven standby pumps if unit capability is to be maintained with the shaft pump out of service. The thermal saving, when using the turbine-driven boiler feed pumps powered with cold reheat steam, ranges from zero to less than 0.1%. This item is not in Table 1.

Results of similar net send-out studies, including those for 6,000 rpm pumps, based on arrangements having equivalent reliability, indicate that motor-driven boiler feed pumps are economically superior to steam turbine-driven pump arrangements for plants up to 325-Mw capacity and with turbine throttle conditions of 2,000 psig/1,050F/1,000F. For larger units or those having higher pressure throttle conditions, higher speed pumps might prove economically desirable. Analysis of such cases may lead to different conclusions.

Fig 3—Typical Cycle Diagram for Cross-Compound Unit with Turbine-Driven Feed Pump

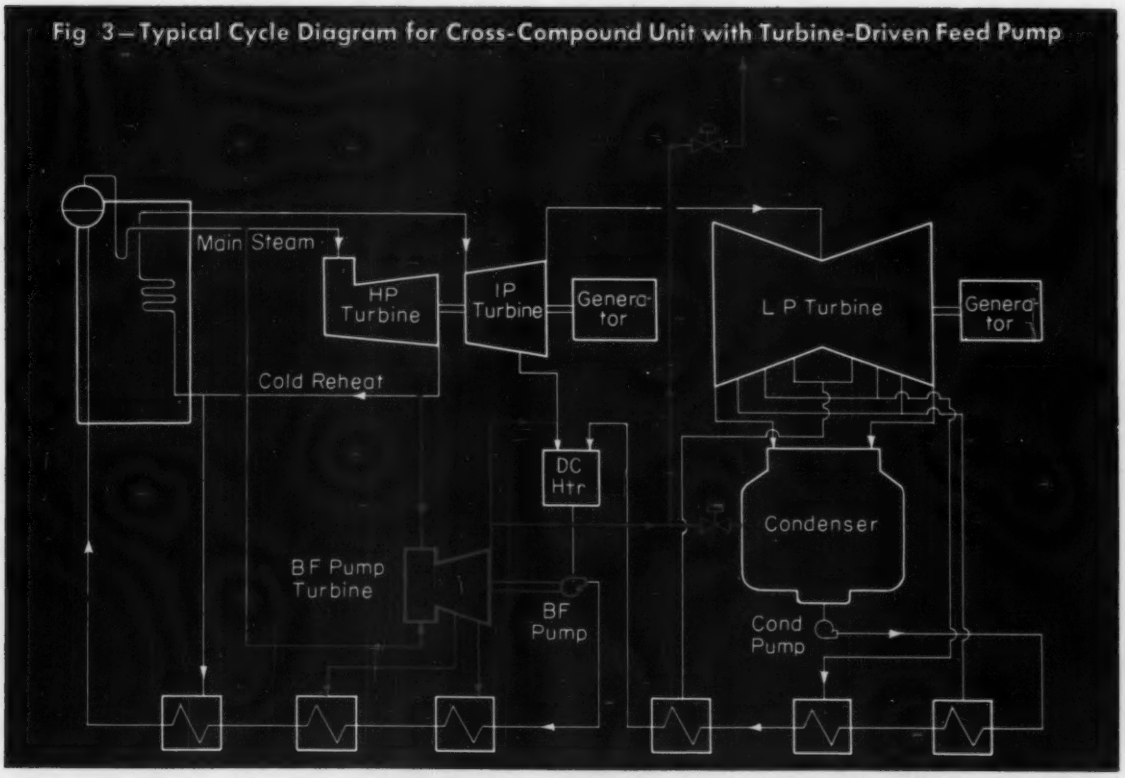


FIG 3—ADDITIONAL MAJOR PIPING is needed in using steam turbine as the prime mover for a boiler feed pump. In the scheme above source of steam for the boiler feed pump turbine is main steam or cold reheat steam lines

Automatic Transfer of Power Plant

Elimination of transfer schemes will enhance simplicity, and minimize cost of auxiliary systems for very large units

C. F. HOCHGESANG, Associate Editor, Electrical World, San Francisco, Calif.

Current steam station design and operating practices rule out justification for automatic transfer of auxiliary systems to stand-by sources. Design criteria emphasizing simplicity of relaying and switching are violated when such transfer schemes are employed. In addition, growth of auxiliary systems to handle very large generating units now becoming commonplace puts an economic deterrent in the path of automatic transfer application.

A design axiom dictates that equipment to perform a function should not be installed if the function is unnecessary. Elimination of equipment avoids added maintenance and removes the factor of possible failures because of the extraneous equipment. This philosophy applied to automatic control relaying is termed "anti-gadgetry".

Necessity Questionable

Analysis of automatic transfer shows its application to be useful so infrequently as to make its necessity questionable. Such schemes have been applied for quick restoration of good-quality power to auxiliary buses in the event of trouble on the power system to which the unit is connected, or upon interruption and shutdown of the unit for any unexpected cause.

It is appropriate to examine the reasoning upon which such application has been based. Normal source of auxiliary power usually is the generator itself, through one or more auxiliary transformers connected directly to the generator leads. The start-up transformer circuit constitutes the stand-by power supply. This is the commonly accepted arrangement for the unit-type systems prevalent today. Fig 1 shows a typical arrangement with the start-up transformer connected to the high-voltage switchyard.

These Initiate Failure

Events which will initiate failure of normal-source power to the auxiliary system fall into these categories:

1. Auxiliary bus faults or bus back-up trips.

2. System-wide trouble resulting in low voltage and/or low frequency on the auxiliary buses.

3. Turbine mechanical trouble, or faults on generator, main leads up to the high-voltage breaker, or main or auxiliary transformer.

4. Inadvertant tripping of generator, auxiliary bus, or turbine because of equipment malfunction or operator's error.

The function of automatic tranfer is considered in each of these categories. When there is trouble on the auxiliary bus, blocking automatic transfer is mandatory. This prevents closing the stand-by supply into a sustained-trouble condition.

Interconnections Help

Power system low voltage or low frequency may occur because of a long-line trip complicated by stability conditions and may continue for some time. Such a situation requires holding all available generation on the line to prevent progressive system deterioration. Automatic transfer of the unit auxiliary system to a source not contaminated by the trouble is an undoubted advantage. But few large modern installations have available such a source (house generator, or high-voltage bus or line) which can be relayed clear of the troubled system quickly enough to be of value. But the trend towards stronger interconnections within and between systems has reduced the likelihood of such widespread system trouble.

Operator Has Time

For the third type of trouble, automatic transfer would switch the auxiliary bus to the stand-by source quickly, should the unit trip. Elec-

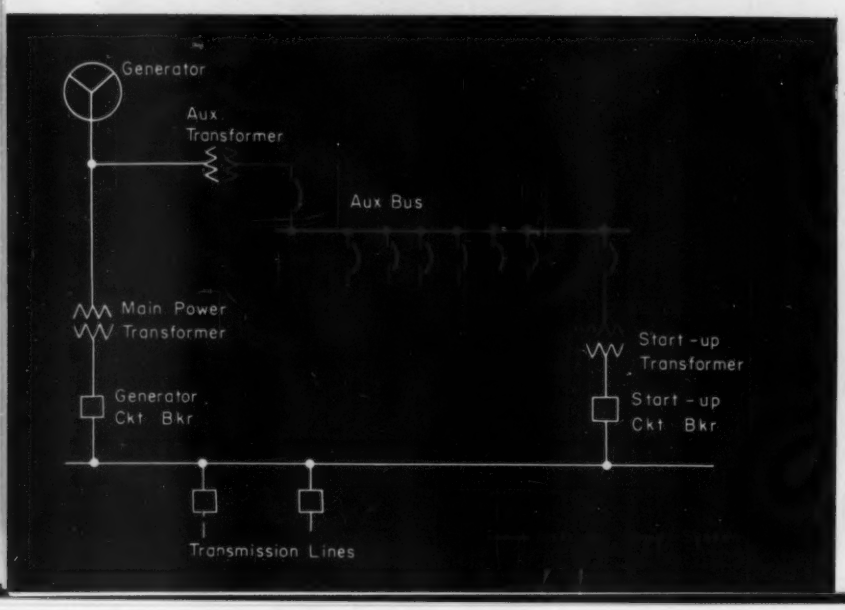


FIG 1 — TYPICAL ARRANGEMENT of the auxiliary power system for conventional unit-type steam station utilizes the start-up circuit as stand-by source

Auxiliaries Shown Unnecessary

trical faults in the generator or its connections, or serious mechanical trouble on the turbine, however, are grave enough to require careful investigation before placing the unit on the line again. Thus, the operator has ample time to switch the auxiliary system manually, so that automatic transfer becomes a luxury.

Remains Only Reason

This leaves inadvertant tripping of the unit because of control equipment malfunction or operator's error as the only remaining justification for automatic transfer in the usual case. But reliability of equipment, such as circuit breakers and turbine stop valves, is no longer questioned so long as routine maintenance checks are programmed. And designing against all possible operator errors as a rigid criterion would lead to unreasonable plant costs.

Safe Shutdown Inherent

It has been argued that, on trip of the unit, automatic transfer would restore auxiliary power as rapidly as possible. No major auxiliary drives would be interrupted for longer than the switching transition. This would permit the operator to shut down the unit in an orderly, controlled, and safe fashion. In actuality, the steam plant designer incorporates as an inherent feature the concept of safe shutdown of the boiler and generator without available auxiliary power. This is done to protect the large investment tied up in the equipment. No argument that the designer should compromise in favor of auxiliary power continuity insured by an automatic relaying scheme, is likely to sway him.

It may be shown that automatic transfer, applied to the very large plants now coming in vogue, introduces side effects which would increase costs appreciably. A typical scheme for auxiliary power supply for a very large cross-compound generating unit is illustrated in Fig 2. A similar scheme is described in the article "Design Simplicity Gives Reliable Auxiliary Power at Least Cost" by F. W. A. Myers, Philadelphia Electric Co (EW, Dec 10, 1956, p 118-119).

Three Transformers Justified

This arrangement would supply 25-40 Mva to the auxiliary load. A cost-saving measure economically justified is the use of three transformers, each capable of carrying 50% of the auxiliary load. All three operate normally, with the auxiliary transformers energizing buses 1 and 2, which carry the major "unitized" auxiliaries. The start-up transformer supplies bus 3, which incorporates common station power requirements.

To apply automatic transfer to this bus arrangement would require switching all auxiliary power to the start-up transformer. This operation would place 100% overload on it. A transformer large enough to carry the entire auxiliary load, even under reasonable, short-time overload conditions, would cost an additional $40-50,000 for the larger kva rating.

Checks Voltage Decay

The well proved relaying scheme normally utilized for automatic transfer checks voltage decay on the auxiliary bus to about 25% of normal before closing in the stand-by source. Thus, for very large plant units, the start-up transformer should have a low impedance to limit the voltage dip on current inrush when the large motors are re-energized. Otherwise, the stand-by source will fail to pick up the auxiliary system. Such a low-impedance transformer, itself penalized in cost by non-standard design, in turn probably would require more costly circuit breakers of higher interrupting duty.

A dollar value cannot be placed on these items without knowledge of the individual case, but this penalty could be substantial. Recent developments, involving other relaying methods, may remove the need for low-impedance stand-by transformers but remain to be proved.

In any event, arguments for necessity of automatic transfer are unchanged.

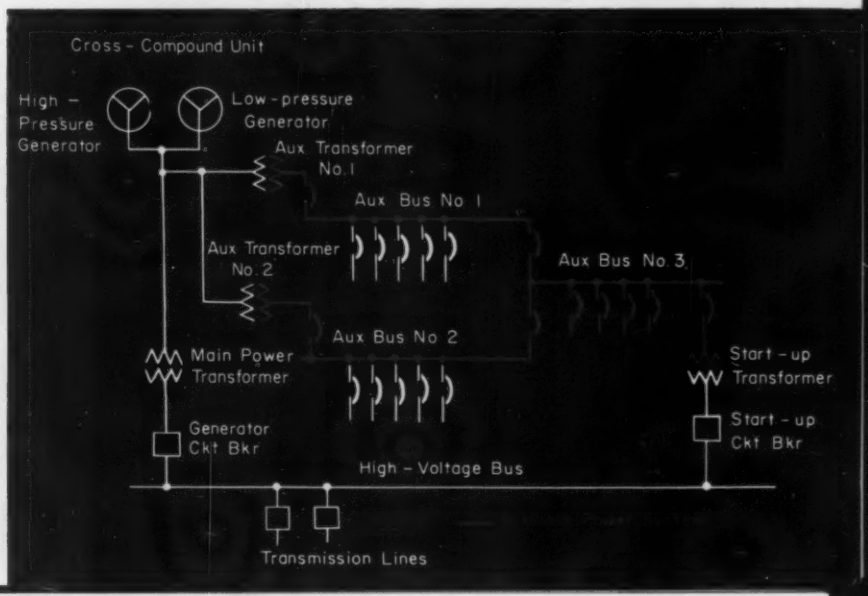


FIG 2 — TRIPLE BUS uses three transformers each rated to carry 50% of auxiliary load. Automatic transfer would require switching all load to start-up unit

Shaft-Driven BF Pumps Cut Cost

Attachment to shaft extension of cross-compound turbine-generators saves about $500,000 on auxiliary power system

D. W. TAYLOR, Assistant Electrical Engineer, Electric Engineering Department, Public Service Electric & Gas Co, Newark, N. J.

Use of main turbine shaft-end feedwater pumps will save about $500,000 on the auxiliary power system of the two new 290-Mw units of the Bergen Generating Station. Cost reduction will be mainly realized by the omission of motors, switchgear, conduit, and cable normally associated with motor-driven boiler feed pumps.

This new station, scheduled for service in 1958, consists of two 290-Mw cross-compound units with steam at 2,350 psig, 1,100F and single reheat to 1,050F. The halves of each unit are both 3,600 rpm, of the same general overall size and the same capacity (EW Nov 12, 1956, p 112).

Auxiliary Needs High

Auxiliary power requirements per unit are estimated to be 20,900 kw. Each half of each cross-compound unit will have a half-size 8,500-rpm, centrifugal-type feedwater pump connected to the main shaft by means of a mechanical coupling, a speed-increasing gear, and a variable-speed hydraulic coupling equipped with an electric brake. The generator rotor can be withdrawn from the armature by removing the speed-increasing gear and hydraulic coupling without removing the feedwater pumps. Thus the main piping need not be disconnected.

Each unit will have a half-size starting and back-up feed-water pump, a duplicate of the shaft-driven pumps with a duplicate speed-increasing gear, driven by a 4,500-hp, 3,600-rpm motor. There will be no hydraulic coupling on these start-up pumps, as during starting the flow will be controlled by valving. And in case the motor-driven pump is substituting for a shaft-end pump at heavy loads, the controller on the other shaft-end pump will be used. The expenditure for the hydraulic coupling could not be justified.

The auxiliary load demands per unit on the electrical system are reduced to 14,500 kw by use of the shaft-end pumps. However the starting feedwater pump motor is the largest in the station, and thus the starting duty on the auxiliary system is the same as if all feedwater pumps were motor-driven.

Auxiliary Voltage 4 Kv

Auxiliary system voltage will be 4 kv. This voltage was chosen as the most economical, as a lower voltage was impractical due to breaker capacities and copper sizes, and higher voltages invoke too much of a cost penalty in motors and switchgear. 4 kv permits reasonable cable sizes, and the currents are within standard breaker capacities. The multiple-bus scheme to be used is quite general for large units and provides operation at half load in case one bus is out of service.

Grounding the 4-kv system through a 5-ohms resistor limits voltage rise on a ground fault. It also permits sensitive and fast ground relay protection. Each 4-kv motor or transformer feed is protected by an induction-type ground relay having a few cycles time delay and tripping on a minimum of about 100 amp.

250-Mva Switchgear Used

Auxiliary system characteristics were calculated on the premise of the voltage being not less than 85% during the starting of the largest motor and the use of 250-Mva, 5-kv switchgear. Interrupting duties and momentary currents are close to the limit for 250-Mva gear.

With motors considerably larger, consideration would have to be given to either reducing the inrush current by reduced voltage starting, the use of two half-size motors or wound rotor motors, and the use of switchgear of greater interrupting capacity, possibly with transformers with split secondaries to reduce the rotor contribution to a short circuit.

440 V for Smaller Motors

Motors below 250 hp will be supplied at 440 v, and the small motors, lighting, and miscellaneous small loads at 220 v. These are supplied from transformers fed from the 4-kv buses.

General purpose auxiliaries are fed from service buses connected only to the back-up transformers. If a back-up transformer or its feed is out of service, interconnections to the service bus of the other unit, mainly at 440 v, will supply sufficient auxiliaries for maintenance.

The starting and back-up feedwater pumps and spare condensate pump are also fed from these service buses. At the time of starting all auxiliaries are fed from this source, and at other times the shaft-end pumps will be the nominal supply.

All 4-kv auxiliary transformers and the 4-kv buses are protected by differential relays. 4-kv motor feeds and transformers feeding the

Large Motors Present Difficult Starting Conditions

	Motor H.P.	Starting inrush percent of full load
Feedwater pump	4,500	600
Air compressor	3,000	600
Exciter	2,800	950
Forced draft fan	2,250	550

The boiler is pressurized so no induced draft fan is required.

lower voltage buses are protected by induction-type relays with instantaneous trip attachments in each of two phases of the circuit and the single induction high-speed ground relay.

Ground faults of values from 100 to 500 amp and phase faults of twice or more motor locked-rotor values should be cleared in 6 to 8 cycles. 440 and 220-v feeders are protected by the trip attachments built into their switchgear.

Transfer of the auxiliaries from the starting or back-up source to the normal source supplied from the generator leads and vice versa will be by dead throwover method. Interlocks are provided so that the two sources cannot be paralled.

Phase-Angle Relay Used

Transfer is initiated by operation of the generator differential relays. Also an undervoltage relay on each of the 4-kv buses will, on the persistence of 70% voltage for a predetermined time, effect the same automatic transfer. No automatic transfer is installed from the back-up source to the nominal source.

Closing of the incoming breaker during a transfer is controlled by a phase-angle relay. This relay initiates breaker closing at a phase-angle difference between the motor residual voltage and the incoming source voltage so that when the breaker contacts touch, this angle is within 60 deg of the proper in-phase position. This limits the in-rush to within the locked rotor values of the motors and results in a throwover time of around 20-40 cycles.

Error Possibility Same

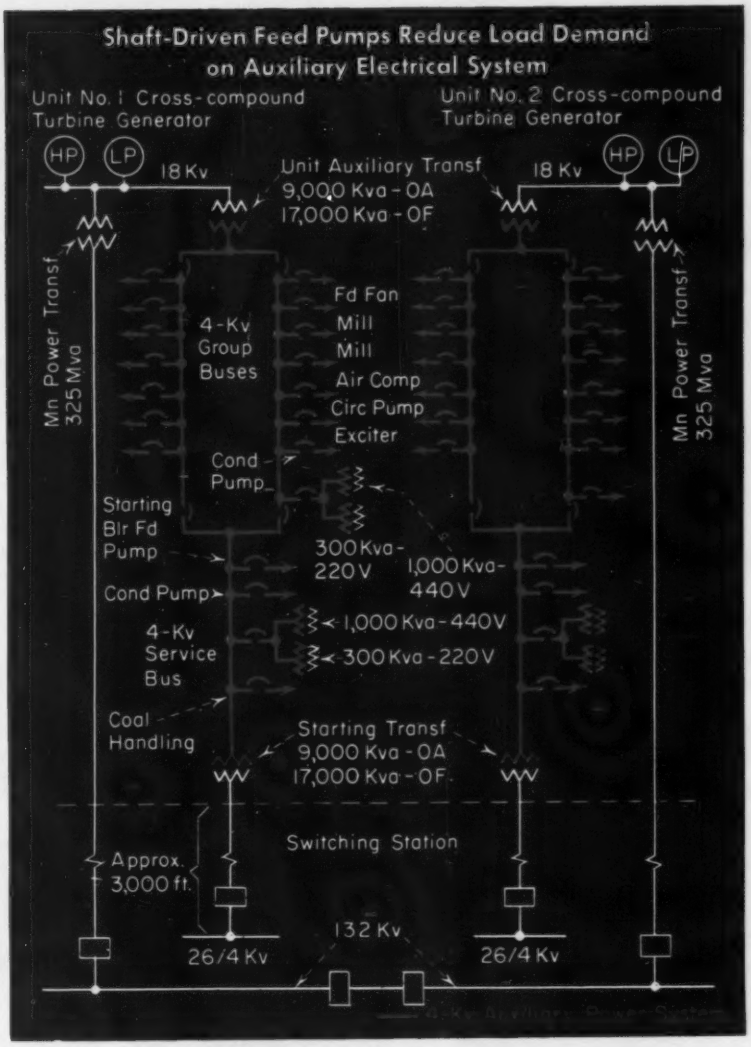
The interrupted source method of transfering the auxiliaries is preferred for the normal manual transfer, as the circuit breakers are always operating within their interrupting capacity. If the two sources are paralleled, for the normal manual transfer, the interrupting duty would be greatly increased, although only during the transfer period. The control complications and the possibility of error seem to be about the same with either method. For the automatic transfer, of course, the interrupted source method must be used.

As soon as the main generators are synchronized, all auxiliaries on the group buses will be transferred to the auxiliary transformer supplied from the generator leads, and remain there until the unit is taken off the line.

Automatic transfer from this source to the starting source is thought desirable as control of the boiler is maintained and should the cause of the tripping of the main unit be quickly remedied, the unit will be returned to service in a shorter time than if all auxiliaries were shut down in an emergency manner.

At full load and summer ambient, the nominal auxiliary transformer will be operated under forced air. The back-up transformers normally will carry only a slight general station load and during the starting period will probably not require forced cooling. When replacing the nominal source, however, with high ambient and full load on the units, forced cooling will be necessary for the transformers.

The 4-kv switchgear units are outdoors and are located with corresponding auxiliary transformers at opposite ends of the station, separated about 450 ft. With this arrangement separate starting or back-up transformers for each unit were estimated to be the most economical method for the alternate auxiliary power source.



4-KV WAS CONSIDERED most economical voltage for electrical auxiliary system. The multiple-bus scheme provides operation in case one bus is out of service

River Rouge Design Conventional

Studies show motor-driven BF pumps, constant speed ID and FD fans with vane control are suitable for new 320-Mv unit

W. W. BROWN, Chief Mechanical Engineer, Detroit Edison Co, Detroit, Mich.

Auxiliary systems and equipment combinations, such as were previously used for units of smaller size, were found best for the new 320-Mw River Rouge Unit No. 3 (EW Dec 3, 1956, p 40). When completed this will be the largest unit on the Detroit Edison system. Steam conditions will be 2,400 psi, 1,050F/1,000F.

Comprehensive studies for the plant auxiliaries led to selection of:

- Constant-speed, ac motor-driven forced and induced draft fans with inlet vane volume control.
- Motor-driven boiler feed pumps instead of turbine-driven pumps.
- An electrical auxiliary system split into two nearly equal parts, each fed from a separate bus.
- 4,160 and 480 v as the auxiliary voltages.

To determine the most economical type of volume control for the fans, inlet vanes with a constant-speed ac motor, inlet vanes with a two-speed ac motor, and hydraulic coupling with a constant-speed ac motor systems were studied.

A comparison of two-speed with single-speed motors indicated that the annual power saving would be about $3,940 with two-speed motors. Capitalized at a fixed charge rate of 12.5%, this is equivalent to $31,500 of investment. However, the increased motor cost and two more starter breakers required an additional investment of $45,000, thus making the two-speed motor application uneconomical.

Still More Expensive

The economic summary, giving a comparison of hydraulic couplings vs inlet vane control with single-speed ac motor, is shown in Table I.

The capacity charge in Table I was developed from the drive power difference at boiler guaranteed capability, and amounts to $62 per kw incremental plant cost. A capacity charge was used although there is always a question as to whether such a "paper" charge should be entered. However, even without consideration of a capacity charge, the hydraulic coupling drive is still the more expensive.

The suggested advantages of hydraulic couplings—less wear and less noise—did not strongly influence the selection. For one thing there will be very little additional blade wear with inlet vanes because of the highly efficient mechanical and electrostatic dust-collectors upstream from the fans. Also, if the hydraulic coupling were used, there would not be much of an erosion advantage, because of the large amount of time this unit will operate at high loads, as shown on the load-duration curve.

There is some noise advantage for the hydraulic coupling but this is not too great because the fan noise level is a function of fan efficiency and not of fan speed. Normally the fan will be operating at design capacity and thus maximum efficiency. Only as the load drops would the fan with the hydraulic coupling maintain approximately peak efficiency, while the fan with inlet vanes becomes less efficient and consequently noiser.

The conclusions reached in this study must, of course, be recognized as applying particularly to the fan equipment purchased for this unit. Other steam-generators with their different fan head-capacity requirements, load schedule differing from that in the load-duration curve, size of the steam-generator, and varying economic considerations could possibly combine in future studies to favor the variable-speed drive.

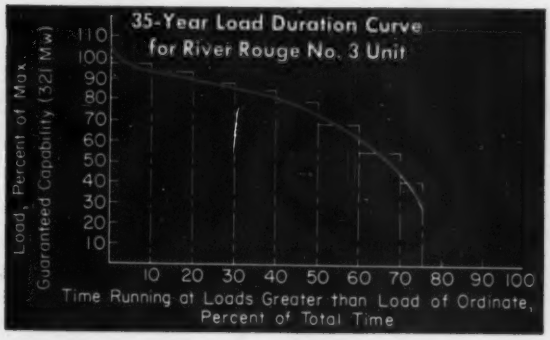
Another study was made to determine the economy of steam-turbine drives on boiler feed pumps. It was based on three half-size pumps for both motor and turbine drives.

Comparison Summarized

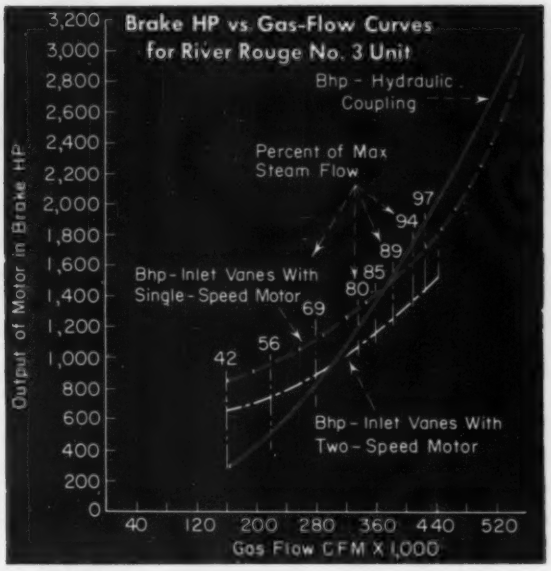
The tabulation in Table II, summarizing the comparison, shows an investment increment of $220,500 for the turbine drive and only an annual saving of $22,500 in its favor. These data indicate an annual return of 10.2% on the estimated increase in investment. It is possible that by adjusting cycle conditions to the operating characteristics of the turbine, and with competitive bidding, a lower price would reduce the investment difference between the two schemes.

Table I—Inlet Vanes More Economical than Hydraulic Couplings for Induced Draft Fan Volume Control

INVESTMENT	Hydraulic Coupling	Inlet Vanes
Two fans	$ 80,000	$ 86,000
Two hydraulic couplings	50,000	
Coupling piping	3,000	
Coupling heaters	1,000	
Two inlet vane sets		8,500
Two outlet dampers	3,800	
Erection	18,500	12,800
Total	156,300	107,300
Capacity charge	23,300	.....
Adjusted total investment	**179,600**	**107,300**
ANNUAL COSTS		
Fixed charges at 12.5%	22,450	13,410
Power cost, superheater side	20,000	22,200
Power cost, reheater side	25,300	25,100
Total annual cost	**$ 67,750**	**$ 60,710**



LOAD DURATION for Unit 3 over 35 year period was studied to determine most economical type of ID and FD fan controls. Curve is put in block form for economic evaluation purposes. Plant factor of curve is 59% based on total time and maximum guaranteed machine capability



COMPREHENSIVE STUDIES favored constant-speed fans with vane controls. Fan head-capacity requirements, load scheduling, and size of steam generator were considered

Also, the capability charge shown against the turbine drive may cause some question. At the outset of the study, the size of the steam generator was limited to 2,000,000 lbs per hr superheater flow because of boiler plant building limitations established by the first two units. Further, it was assumed that the steam supply for the turbine drive would be taken from the cold reheat steam line. Consequently, the reheat turbine output of the main unit was reduced, making necessary a capability charge.

The fuel saving in favor of steam turbine drives has been computed for full load only. The loss by speed reduction in the hydraulic couplings with motor drives would average approximately 10 Btu per kwhr with the expected load range and distribution. If this could all be saved by steam turbine drives, the full-load saving of 30 Btu per kwhr shown would be increased to 40 Btu per kwhr which represents a coal saving of $30,000 per year.

Because the fixed charge rate for investment in power plants is approximately 12.5%, the return of 10.2% was inadequate and consequently the steam turbine drive was not economically justified, on basis of three half-size turbine drives. If one full size turbine drive, together with one reduced-size motor driven pump for start-up, had been considered the conclusions might possibly favor the turbine drive.

Auxiliaries were planned on the "unit basis" in conformity with past practice. Those auxiliaries, essential to the continuous uninterrupted operation of the unit, were split as nearly as possible into two halves, each with its separate bus. Each bus is fed through a separate 12,500-kva transformer connected to the terminal of the generators of the

Table II—Motors Prove Most Economical and Reliable Drive for Boiler Feed Pumps

INVESTMENT ITEMS (only those items that are different for the two schemes are listed)

Motor Drives		**Turbine Drives**	
Three motors (5,000 hp)	$276,000	Three turbines (5,000 hp)	$480,000
Four switch positions, cables, and controls	30,000	Piping investment difference	110,000
9,500kva of transformer capacity (18kv to 4.16 kv)	25,000	One motor-driven boiler feed pumps	70,000
9,500kva of system service capacity (120kv to 4.15kv)	65,000	Capability charge	181,500
Three hydraulic couplings	75,000		
Generator investment difference	100,000		
Reheater investment difference	50,000		
Total for items with differences	$621,000		$841,500

Investment difference in favor of motor drive $220,500

Annual coal saving in favor of steam turbine drive 30 Btu/kwhr 22,500

Return on investment difference $\frac{\$22,500 \times 100}{\$220,500} = 10.2\%$

cross-compound 320,000-kw unit.

With three half-size boiler feed pumps, one auxiliary bus carries its normal load plus an extra 5,000-hp boiler feed pump. The overload capacity of the transformer is used in case the two feed pumps on this one bus must be run in an emergency.

Other loads not so vitally essential are supplied from two system service buses. These loads are plant lighting, coal handling, soot blowing air compressors, half the station air compressors, half the general service pumps, and the plant services. In addition, the system service buses supply start-up, shutdown, and emergency power to the auxiliary buses.

Each system service bus is connected to a transformer which is supplied from the high-voltage switching station. There are three 15,000-kva system service transformers for the three-unit plant.

Favors 4,160 Volts

Two auxiliary voltages were used, 4,160 and 480 v. The primary plant voltage of 4,160 was selected over 2,400 v for the following reasons:

1. The 2,000-amp continuous rating of breakers on available switchgear permits only 8,300-kva load per breaker at 2,400 v, while at 4,160 v this value is 14,400 kva. On a load carrying basis alone, more transformers, cables, and breakers would be required at 2,400 v.

2. The greater interrupting and momentary ratings of available 4,160-v breakers on a kva base permits grouping of larger blocks of motor load without exceeding normal transformer impedances.

3. Cable sizes for the same load are reduced at 4,160 v and cable impedances are less on a 4,160-v base.

4. Voltage drops when starting large motors are within acceptable limits at 4,160 v.

5. When an entire auxiliary bus is disconnected from its normal source and thrown over to the system service bus, the resultant voltage dip on a 2,400-v system would be intolerable while at 4,160 v, with blocks of motors as they exist on this unit, it is tolerable.

All throwovers are of the delayed type with an intentional delay of approximately 1 sec.

Proven System

Unit substations supplied at 13.8 Kv are placed at the load centers. But large unit size imposes some changes in design

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Supplying auxiliary power for the 335-Mw, 2,000-psig, 1,050F/1,000F cross-compound machine for Astoria No. 3 unit follows the same basic philosophy as on the first two 180-Mw generators at this station. In fact, this design is the same as first applied in 1948 by Con Ed engineers for the 220-Mw Waterside No. 1 expansion.

It makes use of unit substation type, load-centers of relatively small transformer capacity being placed wherever in the plant an accumulation of load occurs. These substations have a primary voltage of 13.8 kv and ordinarily a secondary voltage of 440 v.

Operating experience with this type system has proved to be flexible under all operating conditions and maintenance costs have been low. Studies have shown this system to be considerably lower in cost than conventional auxiliary power systems such as are at other stations in the Con Ed system.

There were, however, three major modifications of this design which resulted mostly from the size and type of the turbine-generator for Unit No. 3.

1. The unit will have a 12,000-hp full-size, shaft-driven boiler feed pump. It will be attached to the 3,600-rpm main generator shaft. In addition, there will be two half-size, motor-driven feed pumps, each requiring a 6,000-hp motor. The size rendered 440-v motors impractical so that 4,150-v motors will be used. They will be fed by double-ended unit substations having two 3,000-kva dry-type, sealed-tank transformers, one at each end.

2. Use of motor-generator sets for excitation (shaft exciters were used for Units 1 and 2) required consideration of automatic throwover to the start-up feeder. Studies favored a throwover arangement at 440-v, without deliberate time delay. The motors will be designed to withstand this additional heavy duty.

3. Use of a double bus supplied through an autotransformer from the generator terminals on one side and two autotransformers from a single 27-kv feeder on the other. One major reason for the double bus design is the twin-furnace boiler which facilitates keeping the unit on the line, should half of the auxiliary power supply be lost. Another reason, although a minor one, is the 40,000-kva connected auxiliary load.

The auxiliary power system for this unit will have nine 1,250-kva and six 2,500-kva, 440-v transformers. There will be, in addition, three 937-kva, 120/208-v transformers and for the 6,000-hp feed-pump motors, four 3,000-kva, 4,150-v transformers.

Smallest 50,000 Amp

As in all previous applications of unit substation type of auxiliary power supply, the smallest breaker size is of 50,000-amp interrupting capacity, 800-amp continuous current carrying capacity. This kind of breaker is used as a motor-starting breaker directly, where the motor size justifies this size breaker, or it supplies a number of small motors through distribution panels or motor control centers. For the larger motors, breakers up to 4,000-amp continuous current capacity and 100,000-amp interrupting capacity are used. All breakers are electrically operated and are provided with local and remote control.

Switchgear enclosures are so designed that any breaker may be left in the disconnected position for protection while work proceeds on the circuit it controls with the enclosure doors completely closed to minimize dirt and dust contamination.

The principal reason for the choice of 440-v motors was the desire to use the relatively low-cost, 600-v, circuit-breaker type, switchgear. But the choice had an additional advantage because the

Used on 335-Mw Machine

440-v motor could be obtained in the 1 to 1,000-hp range without an increase in cost.

Because the unit substation transformers are relatively small in physical size as well as cost and are readily replaceable in case of failure, at least one spare transformer for each voltage and capacity rating is provided. When a spare transformer is considered necessary and its cost is included in the evaluation of the system, it was generally found that the extra cost of 440-v motors in sizes above 1,000 hp can often be justified through avoiding another size spare transformer.

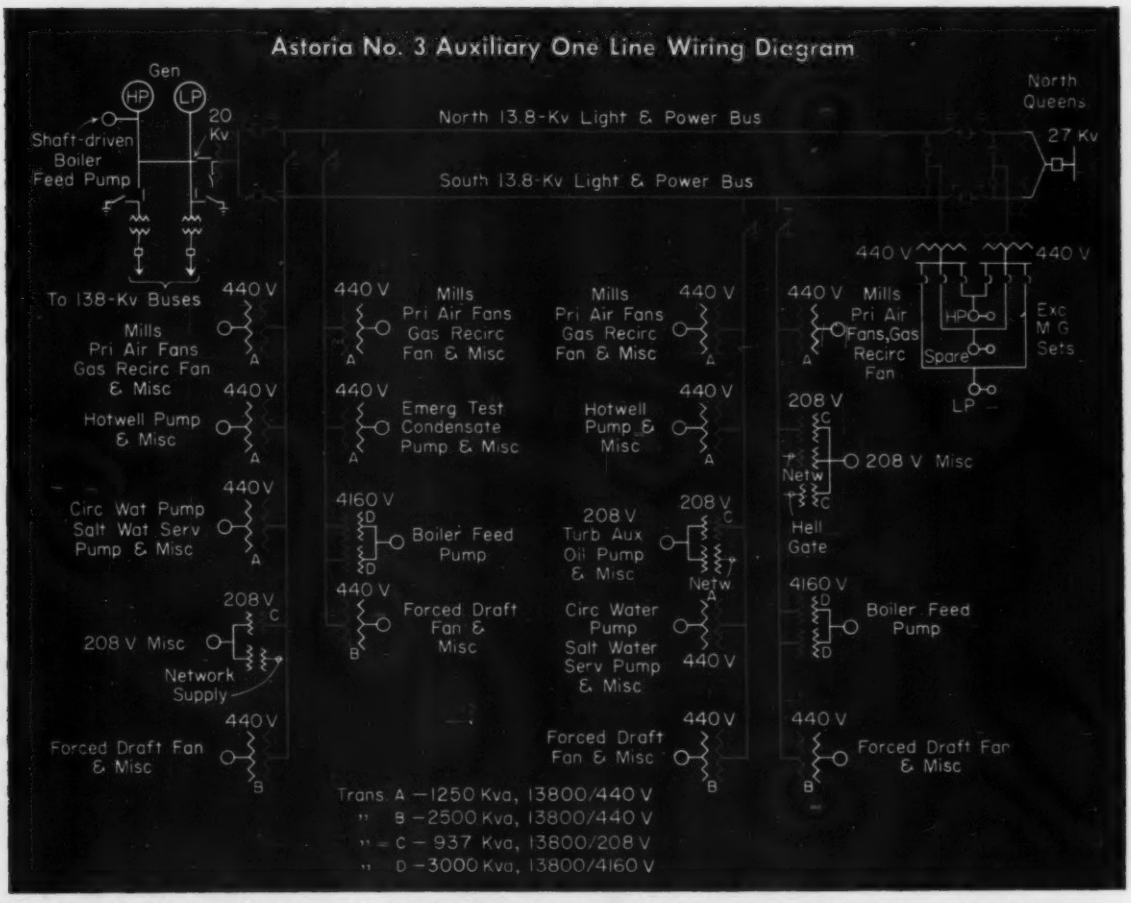
In the overall evaluation there are some factors difficult to measure. One is the increased reliability and better ability to withstand environmental hazards, such as water and steam leaks, of 440-v motors and switchgear over that of higher voltage equipment.

Each of the two 13-kv light and power buses will supply two 13-kv feeders through disconnecting switches, making a total of four 13-kv feeders for the 22 auxiliary power transformers. Because all major auxiliaries come in pairs, it is possible to arrange their power supply circuits so that the failure of either of the two 13-kv supply buses loses only one of a pair.

Results in Tripout

With this arrangement an electrical failure anywhere on a 13-kv cable, or the primary of any one of the transformers, as well as a failure on the secondary side ahead of the motor breaker results in a tripout of one of two auxiliary power buses. When this occurs with the unit in operation, the load would have to be reduced until it can be carried by the remaining auxiliaries which stay alive from the other auxiliary bus. After the defective equipment is located, the corresponding auxiliary power feeder is disconnected from its supply bus which is then restored to operation supplying its second auxiliary power feeder.

The amount of load that can be carried with three of the four auxiliary power feeders in service depends upon what particular piece of equipment is left out of service with the fourth feeder. In any case, at least half of the machine's ca-


Astoria No. 3 Auxiliary One Line Wiring Diagram
Gen
HP
LP
20 Kv
Shaft-driven Boiler Feed Pump
To 138-Kv Buses
North 13.8-Kv Light & Power Bus
South 13.8-Kv Light & Power Bus
North Queens
27 Kv
440 V
Mills Pri Air Fans Gas Recirc Fan & Misc
Hotwell Pump & Misc
Circ Wat Pump Salt Wat Serv Pump & Misc
208 V
208 V Misc
Network Supply
Forced Draft Fan & Misc
Emerg. Test Condensate Pump & Misc
4160 V
Boiler Feed Pump
Turb Aux Oil Pump & Misc
Netw
Circ Water Pump Salt Water Serv Pump & Misc
Exc M G Sets
Spare
LP
Hell Gate
Trans A — 1250 Kva, 13800/440 V
" B — 2500 Kva, 13800/440 V
" C — 937 Kva, 13800/208 V
" D — 3000 Kva, 13800/4160 V

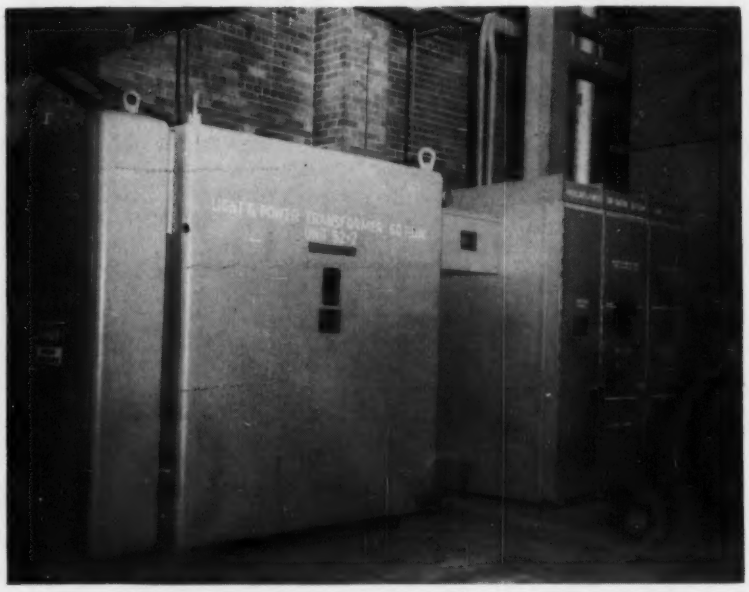
ALL LARGE AUXILIARY MOTORS are fed with 440-kv except boiler feed pump motors which are 4kv. The 13-kv double-bus arrangement provides continuity and flexibility. The total connected auxiliary load is approximately 40,000 kva.

pacity can be carried temporarily.

Higher excitation requirements of the conductor-cooled generators (1,000 kw for each generator) made excitation from shaft-driven exciters impossible without large reduction gears. One exciter motor-generator set for each generator and a third mg set which can be used as a spare for either generator will be used. To simplify controls, each excitation mg set has a complete set of voltage-regulating equipment associated with the set rather than with the generator.

The mg set power supply is from two unit substation load centers, each having a 2,500 kva, 440-v transformer. Each motor-generator has a circuit breaker on each of the two 440-v buses so that the driving motor can be switched from one bus to the other. Normally, only two of the three excitation motor-generator sets will be in operation. Power source from the two light and power 13-kv buses will normally be closed and the selector breakers on the start-up feeder will normally be open. Should one auxiliary power bus be lost, the selector circuit breakers to it will open but the excitation motor-generator sets will remain in operation through the other selector circuit breaker. Only when both auxiliary power buses are lost will the excitation mg sets transfer to the start-up feeder supply.

This arrangement permits maintenance of excitation to the cross-compound generators while keeping the two generators in synchronism. This avoids the time delay that would otherwise occur in waiting for both machines to come to a complete stop in case it were possible to restore power supply in the meantime.



UNIT SUBSTATION load centers are placed in load areas throughout the plant. Switchgear construction is a great aid in reducing maintenance to a minimum

Supplied at 120/208V

One of the most vital supplies of auxiliary power for the turbine-generator is the supply to the bearing oil pumps, the hydrogen gland-seal oil pumps, and the turbine turning-gear motors. As on Units 1 and 2, these essential auxiliaries are supplied at 120/208 v from one of the 120/208-v unit substation load-centers under normal conditions. A manual transfer arrangement is provided by means of which these essential auxiliaries may be switched to the street network which surrounds the Astoria generating station.

Four Emergency Supplies

However, because the network around the generating station is supplied from the North Queens Substation to which Astoria generators No. 1 and 2 connect at 138 kv, it is conceivable that a major catastrophe at the North Queens Substation could interrupt the supply to this network.

Therefore, to insure maintenance of a power supply for the turbine emergency bearing oil pump, the emergency gland seal pumps, and the turning gear motors, a 13-kv feeder is provided from Hell Gate Station with two 937-kva 120/208-v transformers. This provides a third source of supply to these essential auxiliaries.

Steam driven bearing oil pumps provide a fourth emergency supply for the unit.

Why use the unit-substation type auxiliary power system?

1. Development of dry-type, sealed-tank transformers permits location anywhere in plant without vault construction or fire protection.
2. Development of 600-v switchgear with interrupting capacity up to 100,000 amp permits use of time delay protective relaying. With such switchgear applied indoors and enclosed in outdoor non-ventilated enclosures, steam or water leaks are eliminated and maintenance is reduced to a minimum.
3. Circuit breaker sizes are more nearly proportioned to their motor or circuit capacity so that interrupting duty due to the transformer size is rarely a problem as it is in auxiliary systems using large transformers.
4. Load centers can be located close to the load because of small size so that the low voltage connections are very short. Enclosed metal troughs are used for power and control cables. Where the power connections to driven equipment go beyond the one-conductor-per-phase size, bus duct is used.

FROM GENERAL ELECTRIC . . .

NEW, Quiet-operating Boiler Feed Pump Motor

ELECTRIC DRIVES FOR THE ELECTRIC INDUSTRY

With reduced noise level, improved ventilation, Polyex® insulation

WHERE ELECTRICITY IS GENERATED, ELECTRIC DRIVES GIVE TOP PERFORMANCE . . . HERE'S WHY

Progress Is Our Most Important Product

GENERAL ELECTRIC

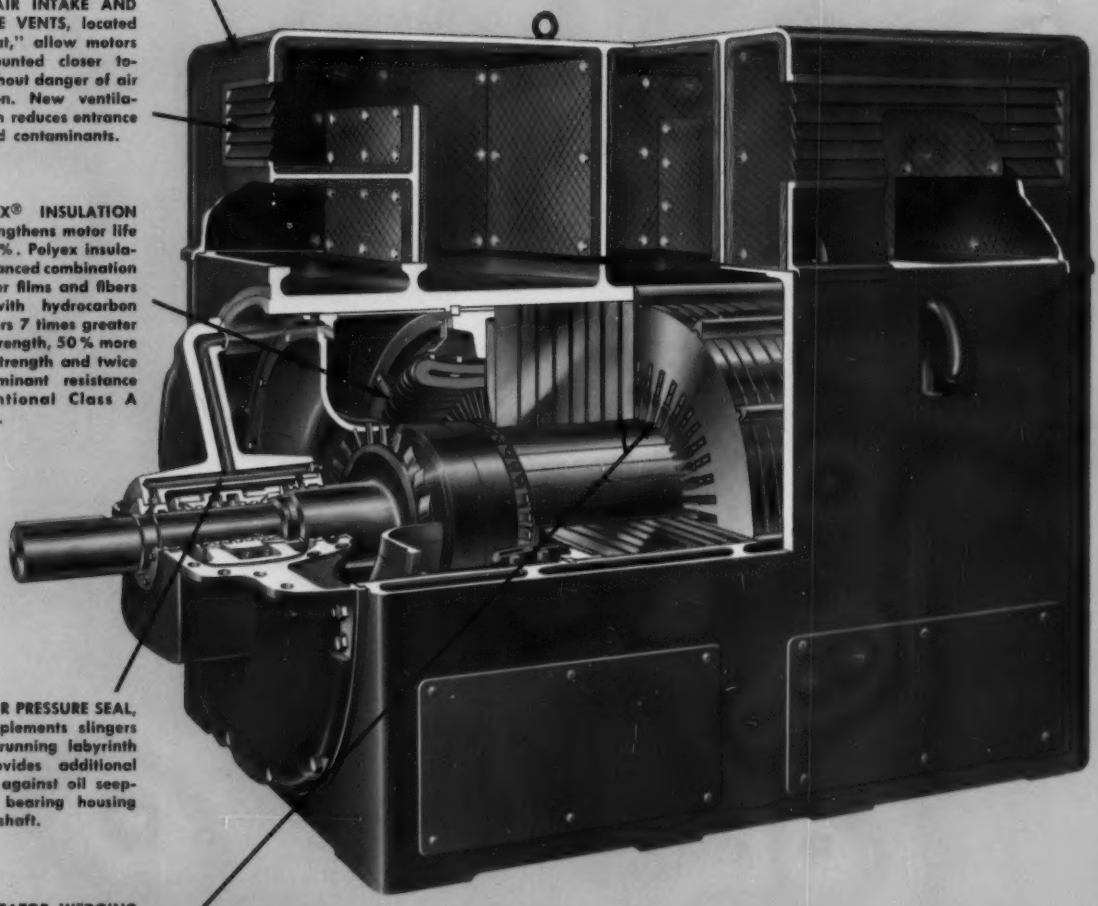
ELECTRIC DRIVES FOR THE ELECTRIC INDUSTRY

NEW General Electric Boiler Feed Pump Motor is designed for quiet operation, long life

1. NEW REMOVABLE "TOP HAT" is designed with a series of chambers and baffles to reduce motor noise level. When "top hat" is lined with sound-absorbing materials, motor noise is thoroughly dissipated and a sonant sound quality results.

2. NEW AIR INTAKE AND DISCHARGE VENTS, located in "top hat," allow motors to be mounted closer together without danger of air recirculation. New ventilation system reduces entrance of dirt and contaminants.

3. POLYEX® INSULATION SYSTEM lengthens motor life up to 100%. Polyex insulation, a balanced combination of polyester films and fibers bonded with hydrocarbon resins, offers 7 times greater physical strength, 50% more dielectric strength and twice the contaminant resistance of conventional Class A insulations.



4. NEW AIR PRESSURE SEAL, which supplements slingers and close-running labyrinth seals, provides additional protection against oil seepage from bearing housing along the shaft.

5. NEW STATOR WEDGING techniques provide tight fitting coils in stator. Non-hygroscopic trapezoidal wedges are individually jacked into slots and cemented to fillers. This tight, stable fit has virtually eliminated coil looseness and resultant wear.

For more information on General Electric's New Boiler Feed Pump Motor contact your nearest G-E Apparatus Sales Office or write to Section 871-1, General Electric Company, Schenectady 5, N. Y.

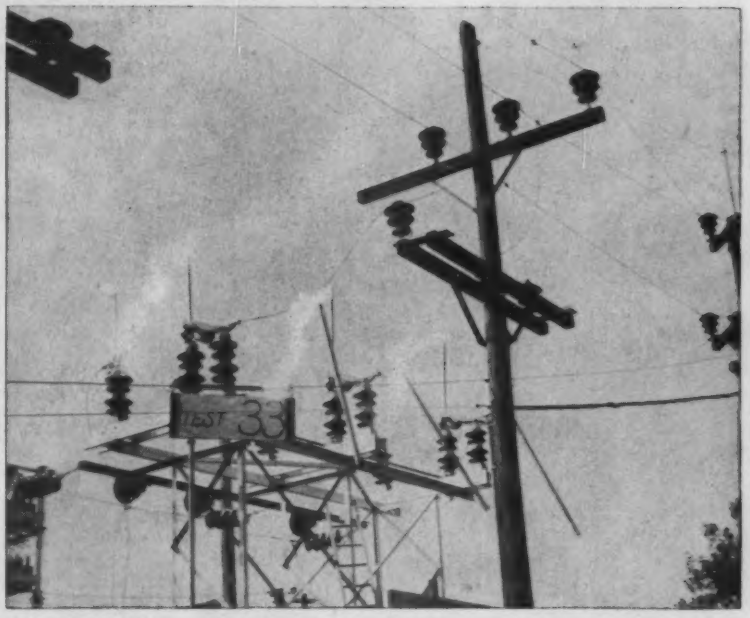
Progress Is Our Most Important Product

GENERAL ELECTRIC

Air-Break Switch Controls 6,000-Ckvar Bank

SUBSTATION—Testing

L. F. MEISENHEIMER, Operating Engineer, System Operating Dept, Duke Power Co, Charlotte, N. C.



For switching capacitor banks up to 6,000 kvar at 44 kv Duke Power Co uses an air-break switch. A recent test showed that this use of an air-break switch, besides reducing costs by eliminating an oil circuit breaker, maintains about the same bank protection.

Cameras Film in Color

The tests were conducted on a 69-kv air-break switch having a 28-in. quick-break arm. The switch was installed at a substation where there are two 6,000-kvar, 46.2-kv capacitor banks normally controlled by two oil circuit breakers. The wiring was arranged to permit the air-break switch to control one bank with back up from a circuit breaker.

The tests' primary aim was to determine the ability of the switch to control single and parallel capacitor banks. Information was also sought on transient voltages and currents during the switching of large blocks of high-voltage capacitors. Accordingly, a magnetic oscillograph recorded the following measurements:

1. 3-phase line-to-neutral voltage on the bus side of the switch.
2. 3-phase line-to-neutral voltage on the load side of the switch.
3. 3-phase amperes through the switch.
4. Neutral current in the capacitor bank connected double wye.
5. Travel indication of the switch arm.

Two high-speed cameras filmed in color all openings and closings of the switch.

PTs Eliminated

Special capacitor devices were developed by the company to obtain voltage measurements and eliminate the need for six 44-kv PTs. Each device consists of 14 capacitors, rated 0.03 μf at 7.5 kv dc, connected in series within a fiber tube. Calculations indicate that each capacitor operates between 1.7 and 2 kv ac, which is within allowable limits. For measurements, the bottom unit was tapped, and the resulting voltage was stepped down with 20:1 PTs.

As a safety factor all capacitors in the device were pre-tested at 5 kv ac. Several units were tested for breakdown. It was found that internal gaps broke down between 13 and 14 kv without damaging the capacitors.

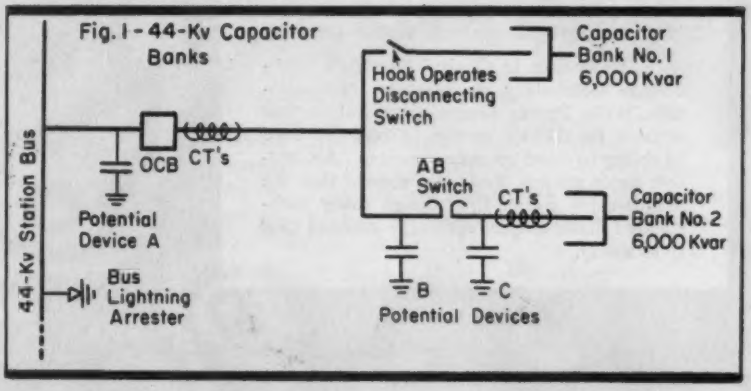
Distortion Considerable

Oscillograms of the output wave from the potential devices showed considerable distortion. Compensation would have corrected this condition but was considered unnecessary.

Test results indicate that the switch successfully closed and interrupted

(*Continued on page* 98)

Fig. 1 - 44-Kv Capacitor Banks



Adapted from a paper presented to Southeastern Electric Exchange Engineering & Operation Section meeting at Richmond, Va.

GENERAL ELECTRIC

Out of General Electric research .

PERFECT SQUELCH

for a 7½-million-volt direct stroke

Here, under test in General Electric's High-Voltage Laboratory at Pittsfield, Massachusetts, is the Thyrite Magne-valve Station-type arrester for 330-kv service. Arrester proved its ability to stand up under repeated 7,500,000-volt direct strokes. Tests also showed that the Magne-valve station-type design easily withstands 150,000-ampere discharge currents (5 × 10 μs wave).

. . . Magne-valve—the principle that gives

PROVED LIGHTNING PROTECTION FOR YOUR ENTIRE SYSTEM

First developed by G-E engineers in the mid-1940's, the proved Magne-valve principle of operation has been applied to an entire line of General Electric arresters. They are applicable to every part of your system, from large station apparatus to distribution lines. They give the best over-all lightning protection ever offered.

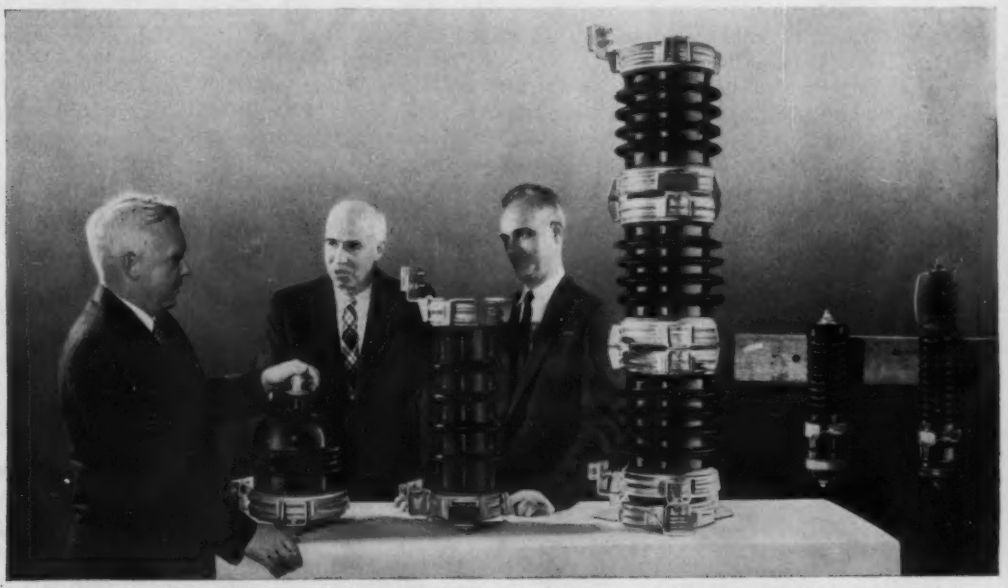
Developed through G.E.'s unique research facilities, Magne-valve combines the efficient valve action of Thyrite* disks with a new magnetic action to positively interrupt power follow-current. Magne-valve has up to 3 times greater discharge capacity to withstand multiple strokes and long-duration discharges. It gives maximum protection during severe switching surges.

Magne-valve Station- and Line-type Arresters give 20% **more** protection than previous designs. Station arresters permit reduced insulation levels (one or two steps) in power transformers rated 138 kv and above. They give more positive protection to older apparatus having low insulation levels. Both station and line types offer a valuable extra margin of protection where power lines or substations are not shielded or where shielding alone may not be sufficient.

New Magne-valve Distribution Arresters bring to distribution circuits the same advantages of the Magne-valve principle so successfully used in G-E Station- and Line-type arresters. They offer the best in protection and are the smallest and lightest valve-type arresters on the market today. They have superior discharge capacity and can be applied anywhere on the system, regardless of short-circuit capacity.

For full information, contact your G-E Apparatus Sales Office or write to General Electric Co., Section 432-21, Schenectady 5, N. Y.

**Reg. Trade-mark of General Electric Company for molded resistance material.*



A MAGNE-VALVE ARRESTER FOR EVERY APPLICATION G-E engineers A. A. Olsen, Dr. E. A. Evans, and T. J. Carpenter, Coffin award winners for the design and development of Thyrite and Magne-valve, are shown here with representative examples of General Electric Magne-valve arresters.

Progress Is Our Most Important Product

GENERAL ELECTRIC

single banks from 2,400 through 9,600 kvar in progressive steps of 1,200 kvar. During repeated tests at 8,400 and 9,600 kvar the quick-break attachments failed to interrupt the load current, and the arc was interrupted by the back-up breaker.

Both single and parallel banks totaling 6,000 kvar each were successfully switched six consecutive times, indicating the ability of the switch to interrupt capacitive load.

Charging Duty Severe

When switching parallel banks, severe duty is placed on the air-break switch during the charging cycle. High inrush current of about 14,000 amp created an unusual arcing condition accompanied by a loud explosive sound. The high current and its frequency could not be accurately recorded by the oscillograph, but oscillograms indicated that they did occur.

Opening of the switch on parallel banks produced no greater arc drawout than when interrupting single banks of the same capacity.

The high-speed movies help explain certain arcing problems recorded on the oscillograms. These disturbances were probably caused by double arcing of the switch when load was transferred from the arm to the main contact and vice versa. If pre-strikes did occur, they were not immediately discernible on the oscillograms.

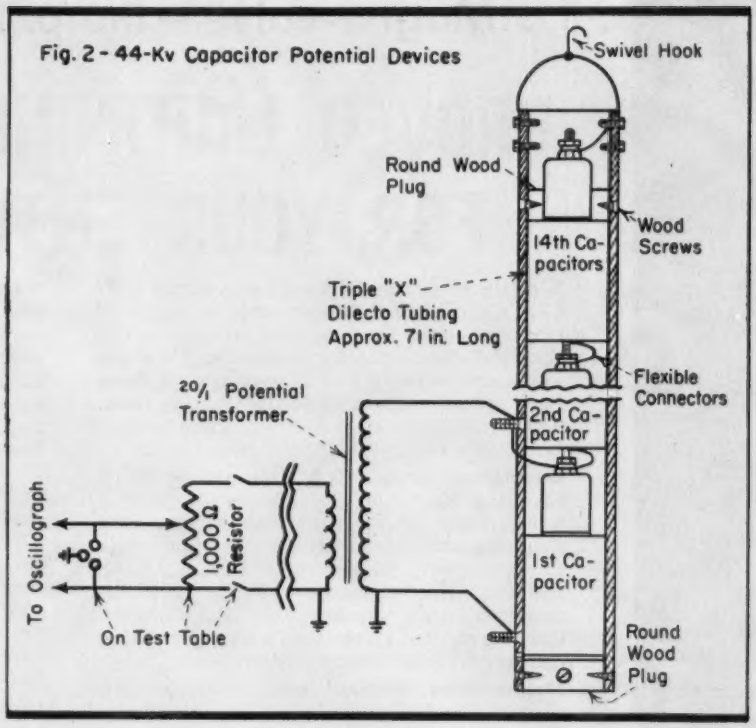
Switching operations on a capacitor bank can create overvoltage on one or more phases due to voltage pre-strikes or re-strikes. From the oscillograms, voltage re-strikes probably occurred in three out of 19 opening tests.

During one test, the phase voltage on the bank peaked 40% higher than normal for ½ cycle, due to a re-strike, but returned to normal during the next ½ cycle.

But there were no indications of two, three, or more times normal voltage on the bank. This does not mean that such overvoltages cannot occur but rather that they appear to be a minor problem.

From operating data collected since the tests were made, more than 100 successful closings, plus openings, have been made on the switch and capacitor bank.

Fig. 2 - 44-Kv Capacitor Potential Devices



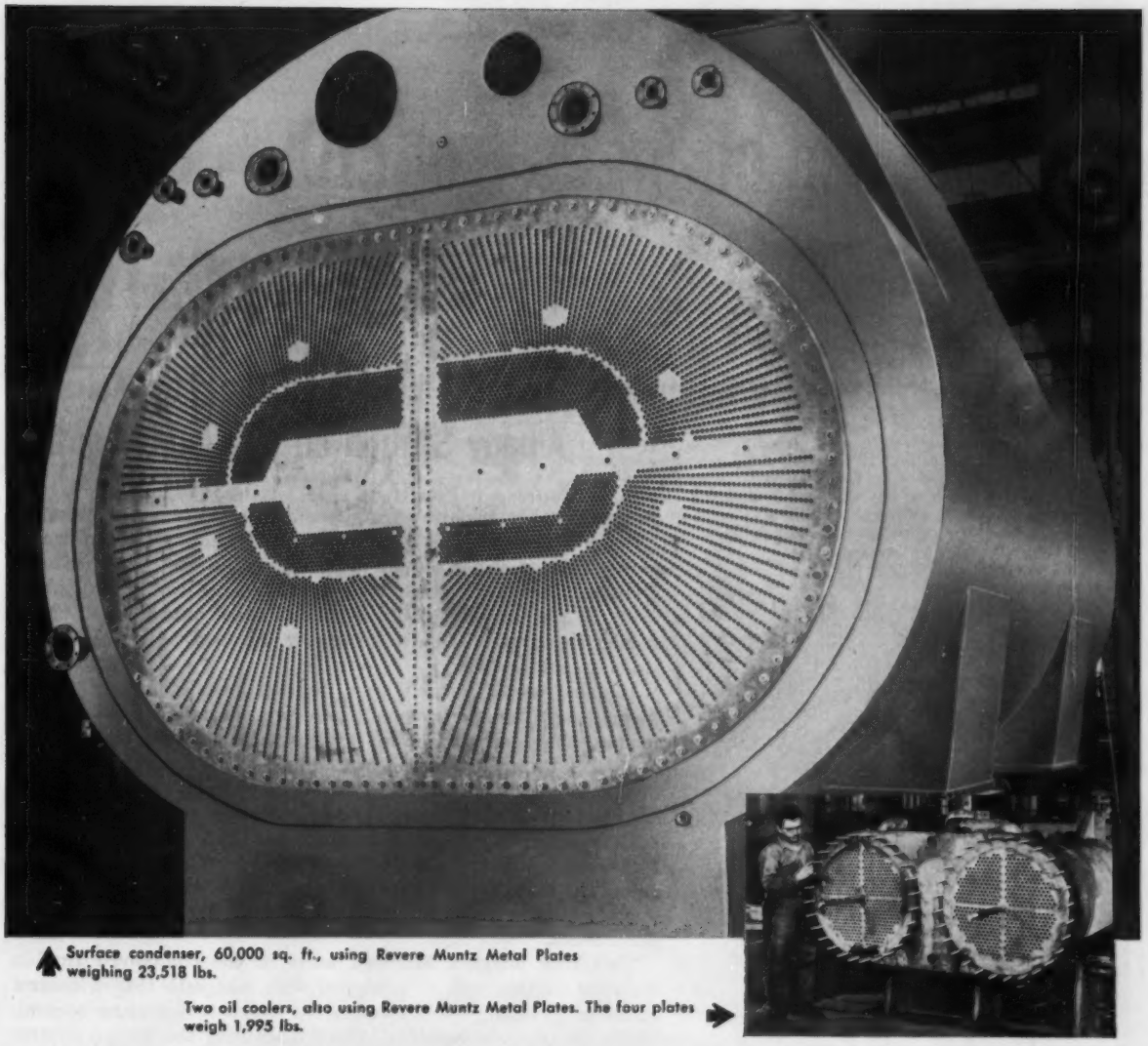
DISTRIBUTION—Design

Pole Carries Cluster of 12 Capacitors

Cluster mountings of 12 50-kvar capacitor units are installed by Dayton Power & Light Co to obtain a heavier concentration of capacitors on a single pole.

Mounting steel, heavier than that for transformers and 25-kva capacitor units, provides the strength for the larger installations. Adjustable bracings allow the units to be plumbed for neat appearance.

(*Continued on page* 102)



Surface condenser, 60,000 sq. ft., using Revere Muntz Metal Plates weighing 23,518 lbs.

Two oil coolers, also using Revere Muntz Metal Plates. The four plates weigh 1,995 lbs.

LARGE PLATES FOR CONDENSERS

. . . SMALL FOR OIL COOLERS

REVERE SUPPLIES THEM BOTH!

These two pictures offer a great contrast in the size of the equipment. The large condenser has 60,000 square feet of surface, the small oil coolers only 1,100 square feet. Both were made by Westinghouse Electric Corporation, Steam Division, Philadelphia, Pa., for the Columbus & Southern Ohio Electric Co., Columbus, Ohio. Revere supplied 23,518 lbs. of Muntz Metal plates for the condenser. There are four plates, 113½" x 153" x 1¼" thick, hot rolled and leveled, cut to pattern. The oil coolers required four Muntz Metal circles, weighing 1,995 lbs. Two are 35¼" in diameter and 1¾" thick, and two are 31¾" in diameter by 2" thick. The units are for the utility's Picway generating station, for use with a 100,000 kw. turbo-generator.

Revere supplies condenser and heat exchanger plates and tubes in all the usual alloys, including not only Muntz Metal, but Admiralty Metal, Aluminum, Bronze and Brass, and Cupro-Nickel. The latter is especially advisable for difficult water conditions, such as salt, brackish or heavily contaminated water. Selection of the correct alloy to meet actual operating conditions may at times be a problem. Consult Revere. We will be glad to collaborate on such matters, and recommend the alloy most likely to serve long and economically. See the nearest Revere Sales Office.

FREE. Send for your copy of the informative booklet, "Life Extension for Condenser Tubes." Contains much basic technical as well as practical information for designers and plant operators.

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Station Load changes from 100% to 12%

...ON AUTOMATIC CONTROL

Hagan Automatic Systems help keep Niagara Mohawk Albany Station on frequency control

A new station seldom encounters as drastic load changes as Niagara Mohawk's Albany Station. At the end of a chain of water power stations, it has the job of taking up the slack as water level and power demand varies. During the spring season, it may swing from 50 MW at night to its maximum rated output of 400 MW during the day. No matter how low the load falls, the station stays on automatic.

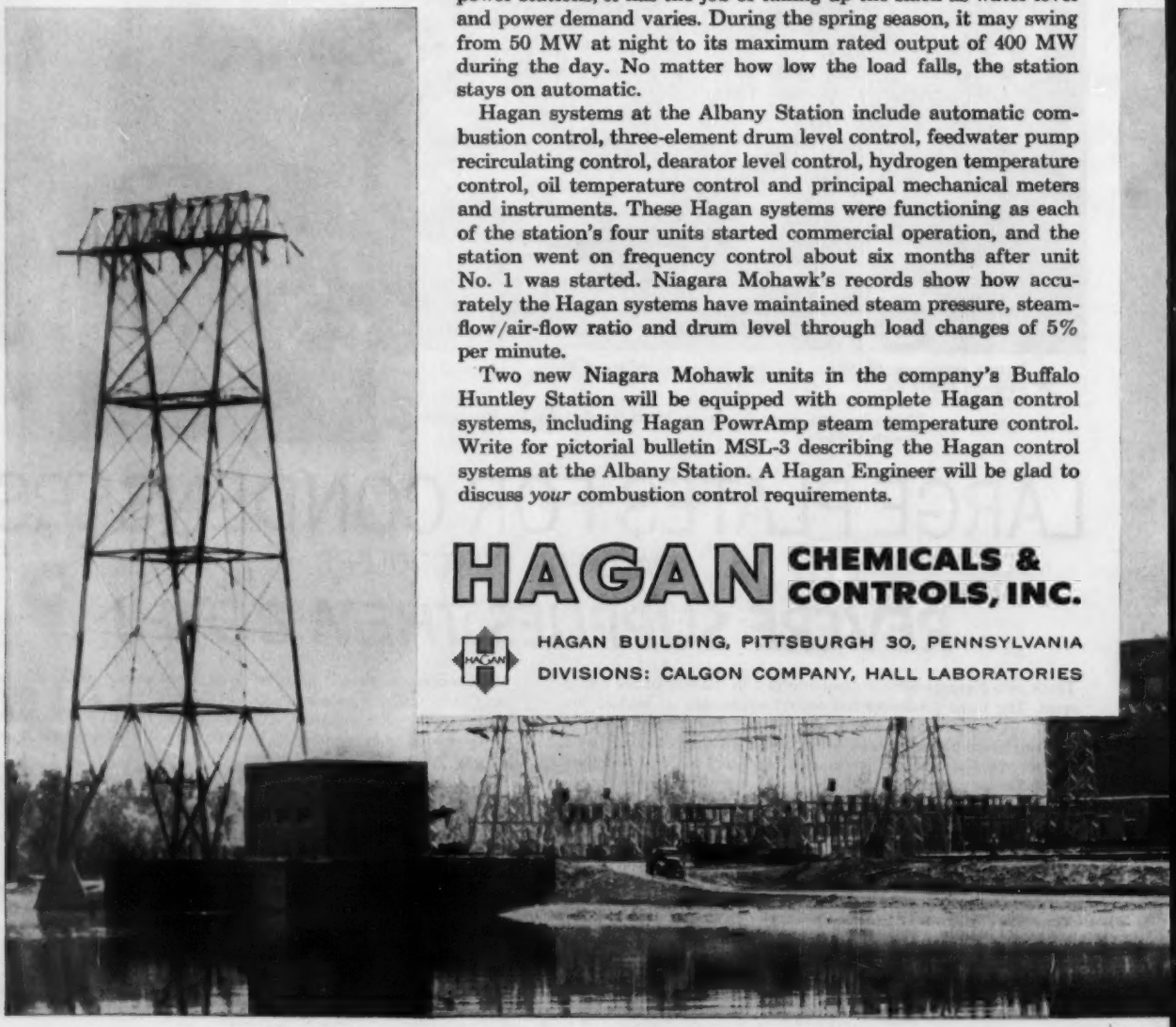
Hagan systems at the Albany Station include automatic combustion control, three-element drum level control, feedwater pump recirculating control, dearator level control, hydrogen temperature control, oil temperature control and principal mechanical meters and instruments. These Hagan systems were functioning as each of the station's four units started commercial operation, and the station went on frequency control about six months after unit No. 1 was started. Niagara Mohawk's records show how accurately the Hagan systems have maintained steam pressure, steam-flow/air-flow ratio and drum level through load changes of 5% per minute.

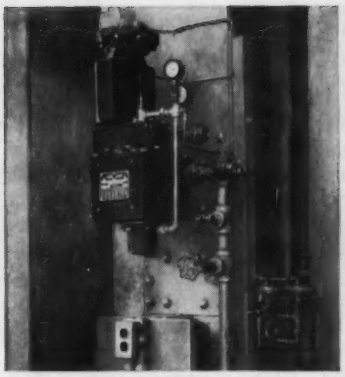
Two new Niagara Mohawk units in the company's Buffalo Huntley Station will be equipped with complete Hagan control systems, including Hagan PowrAmp steam temperature control. Write for pictorial bulletin MSL-3 describing the Hagan control systems at the Albany Station. A Hagan Engineer will be glad to discuss *your* combustion control requirements.

HAGAN CHEMICALS & CONTROLS, INC.

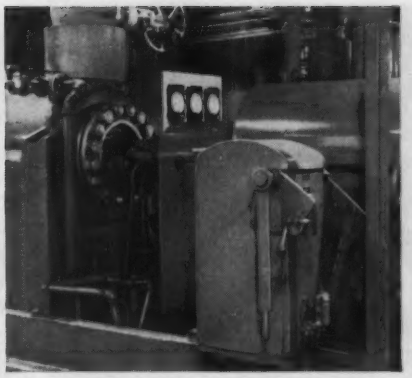
HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA

DIVISIONS: CALGON COMPANY, HALL LABORATORIES

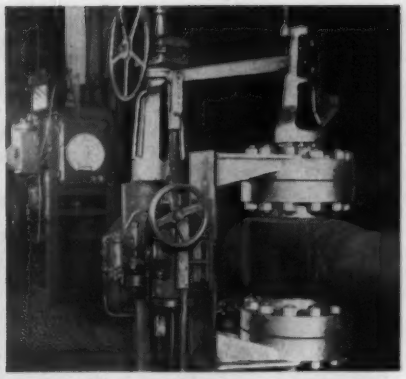




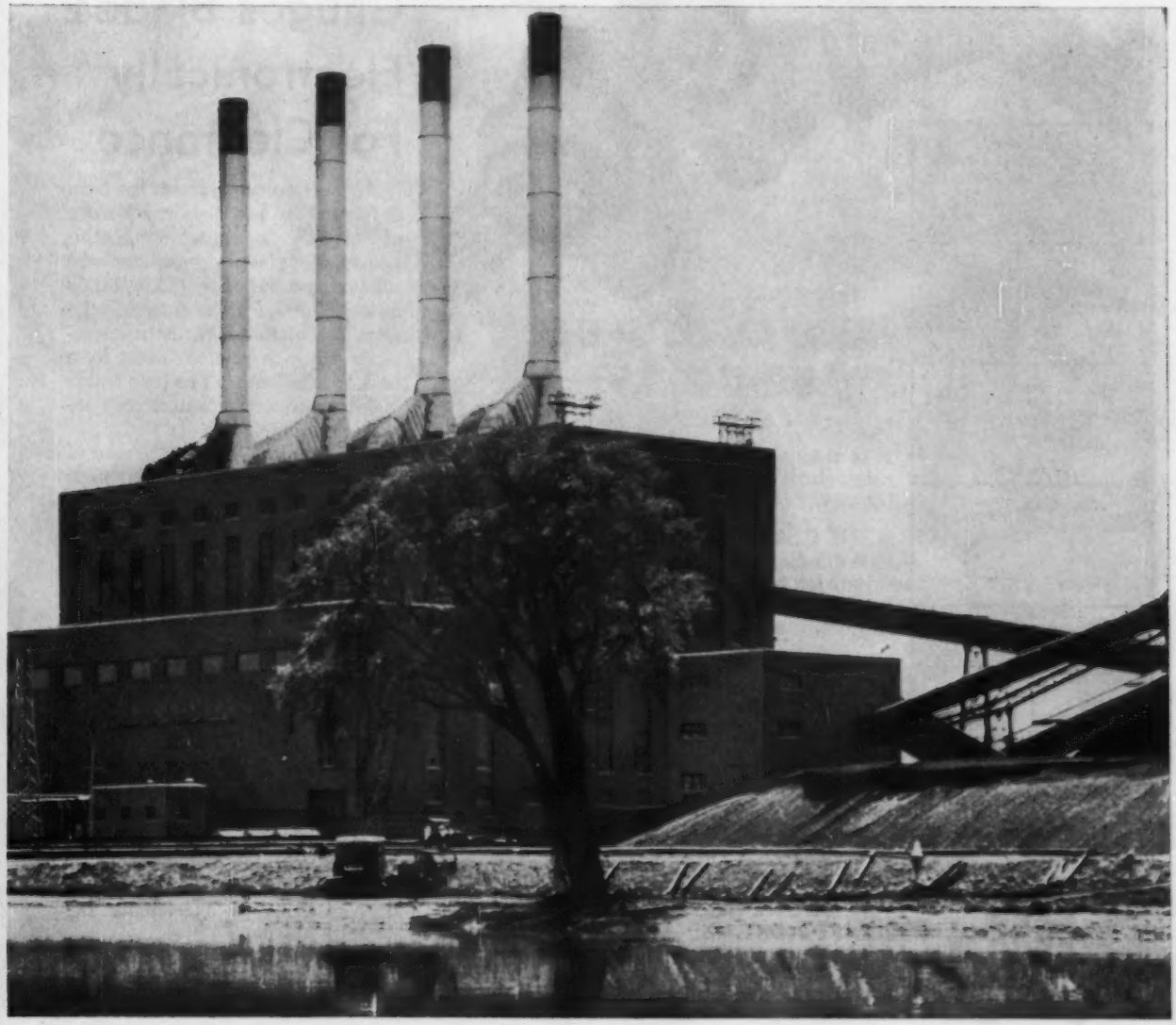
Hagan Furnace Pressure Regulator. This installation is equipped with the Hagan remote switching system, eliminating the lag normally present in long-line pneumatic systems. Controlling the Forced Draft Fan inlets, this Hagan Regulator is a unique instrument. Instant response, high stability and wide range adjustment makes the Hagan Regulator easy to tailor to a specific application.



Boiler Feed Pump Hydraulic Coupling Control. Here a 6 x 10 Hagan Power Positioner implements the signal from the feed water control. This Power Positioner is one of a full range of sizes suitable for many positioning applications. Hagan Power Positioners are fast and accurate, with dependable repeatability. The panel in the background contains Hagan Ring Balance meters which record the three separate flows, totalize each flow and record the total of all three.



This 5 x 10 Hagan Power Positioner positions the feedwater control valve. Normally on standby, this valve is an alternate means of feedwater control. The Hagan Ring Balance Meter in the background transmits boiler drum water level, compensated for changes in density. This provides reliable and accurate drum level reading from atmospheric pressure to full operating pressure when going on or off the line. For details on this unique system, ask for Bulletin MSA-117.



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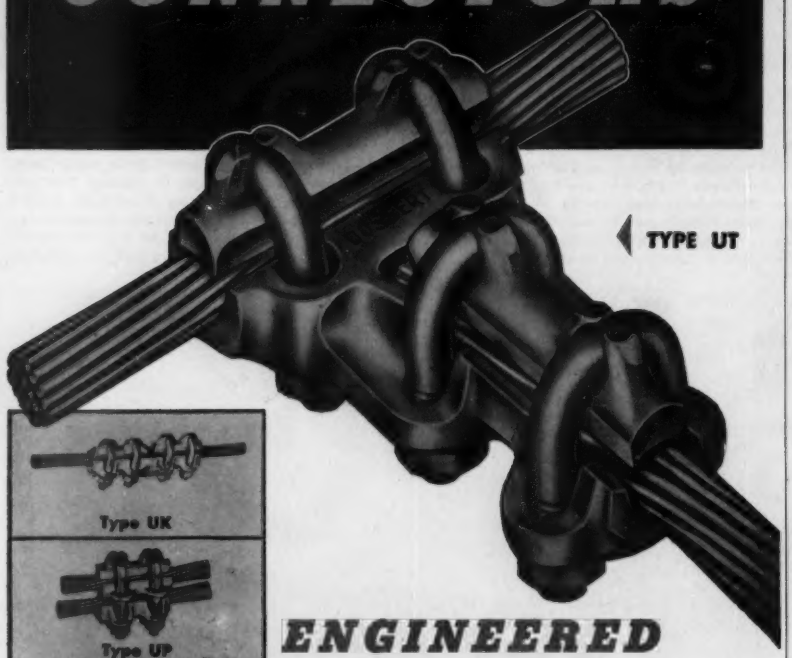
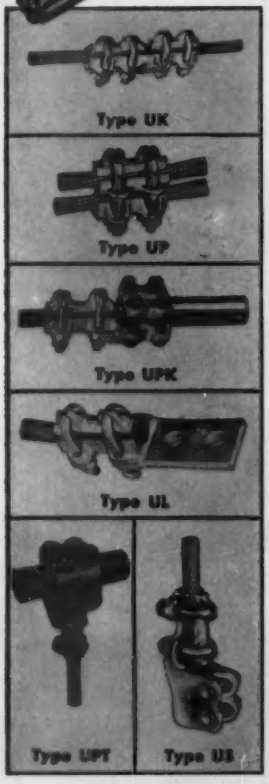
CONNECTORS





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Fits many cable sizes, reduces number of connectors needed for given number of combinations of conductors.

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U-Bolts clear all conductors by close limits, supported by saddles through their full arcs. Minimizes bending action, makes U-Bolts subject to tensile stress only.

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50 YEARS OF TECHNICAL KNOW-HOW

DOSSERT MFG. CORP.
249 Huron Street, Brooklyn 22, N. Y.

12 Capacitors

(*Continued from page* 98)

The capacitor clusters are on circuits where the fault duty is less than 5,000 amp. Fused cutouts of sufficient interrupting capacity are of a type that can be opened under load by a portable load-interrupter tool. They are intended for capacitor switching and to interrupt the circuit for faults.

Capacitors, installed four per phase, are fused in groups of four, 50-kvar units. The neutral is grounded solidly; the capacitor groups are wye connected.

GENERATION—Testing

Gauges Blades Electronically For Clearance

An electronic instrument has been developed by the National Bureau of Standards for measuring continuously the clearance between the rotating and stationary blades inside a steam turbine. The detecting element is a mutual-inductance micrometer probe in printed circuit form on a ceramic base. The base resists high-temperature steam erosion inside the turbine.

Designed for the Navy Bureau of Ships by M. L. Greenough and J. Johansen of the bureau's electronic instrumentation laboratory, with assistance of other sections of the bureau, this rotor-position indicator aids in study of steam turbines in actual operation.

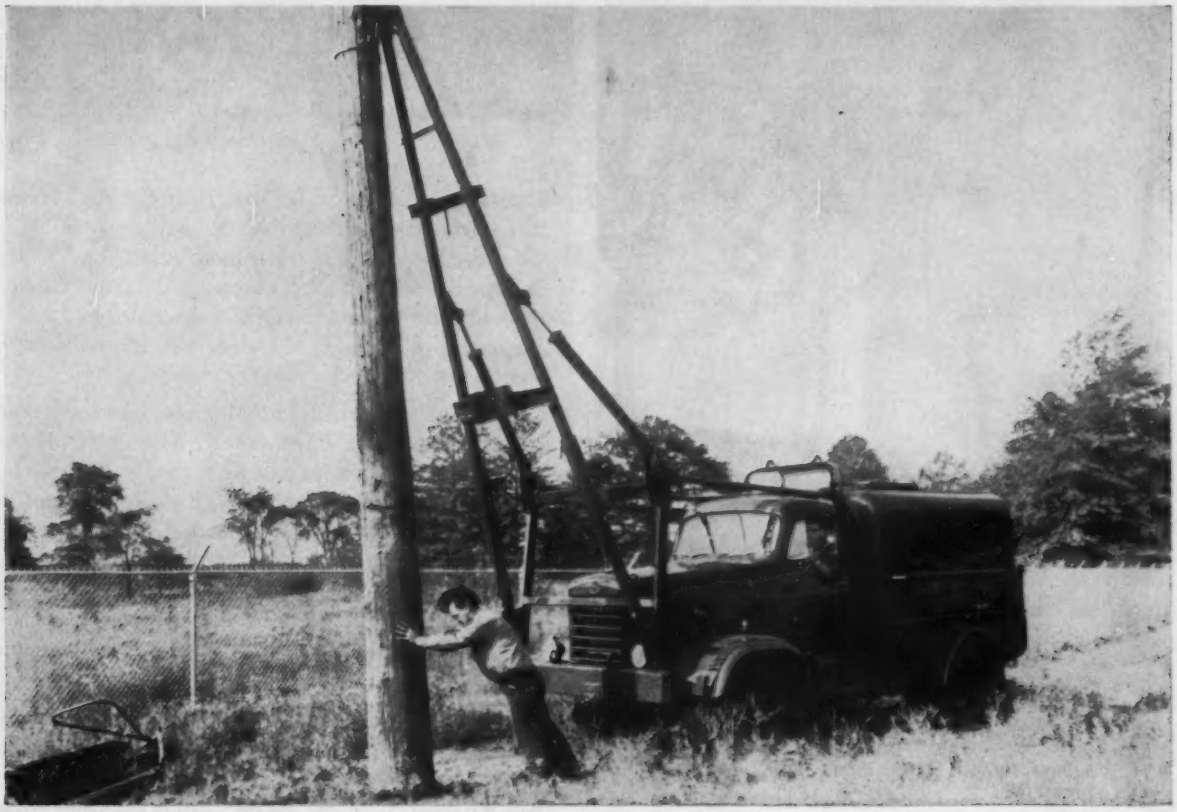
Axial Clearance Problem

One problem in steam turbine operation is maintenance of safe axial clearance between rotating and stationary blades. Rotor and stator blade assemblies are supported, respectively, by the massive rotor and the relatively thin outer casing. Thus transient thermal conditions cause large differential expansions, possibly resulting in interference between the blades.

The rotor-position indicator permits accurate determination of blade

(*Continued on page* 106)

New FWD 2-Man "Rhino" Does 5-Man job in less time



HERE'S DEMONSTRATED PROOF: In the toughest kind of utility job tests, the new FWD "Rhino" has repeatedly proved it can dig more holes, set more poles . . . with fewer men!

The rugged-built "Rhino," with FWD's special power and weight proportioning, makes it practical to handle massive front-end loads . . . has the only *true* "full-time" four wheel drive. Equipped with a heavy-duty 9500 lbs. front axle, the "Rhino" carries front-mounted derrick and digger through the toughest kind of off-highway terrain.

The "Rhino" gives the driver full visual control at all times. No need to jockey back and forth. He just drives into position where the second man handles the digger or positions the pole. In any terrain, these two men will dig more holes, set more poles than five men . . . in less time!

Heavy-Duty Vehicle Specialists

THE FOUR WHEEL DRIVE AUTO COMPANY • Clintonville, Wisconsin • *Canadian Factory* • KITCHENER, ONTARIO

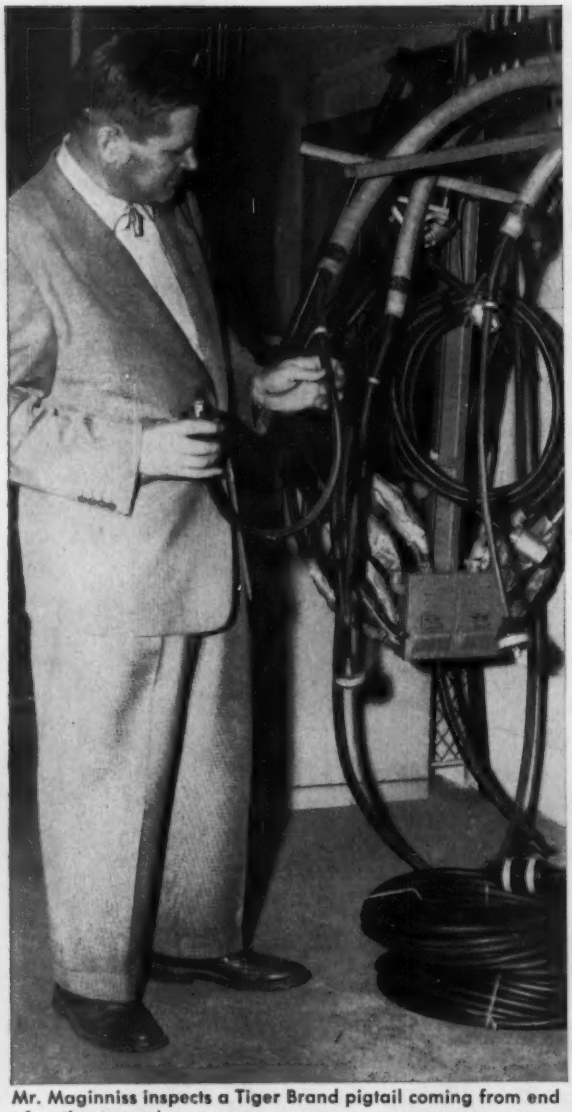
"We've never had a complaint about Tiger Brand Amerclad!"

says H. J. Maginniss, President
Maginniss Power Tool Company, Mansfield, Ohio

Here's a success story for you. In 1947, Mr. Maginniss started his company with one employee—himself. One year later, he added one more employee. Today, he has 35, and business is booming. His only product is an electric generator-vibrator system that knocks the entrapped air out of freshly poured concrete so that it is denser and stronger.

Early in the game, Mr. Maginniss learned that construction men did not exactly baby his tools. As a result, everything is built as ruggedly as possible, and that includes the cable, which is four-conductor, No. 12 AWG Tiger Brand Amerclad. Sometimes the cable drapes over several stories of scaffolding and is dragged over rough concrete, wooden beams and steel piling—while heavy trucks roll over it down on the ground. Despite all this, they have never had a complaint about the cable.

Do *you* need this kind of quality? Your AS&W salesman will give it to you!



Mr. Maginniss inspects a Tiger Brand pigtail coming from end of a vibrator tool.

Harry Bunton paints a vibrator. Notice heavy casing around cable near the hand hold.

Here is a cable casing that was damaged in use. Cable inside was not injured.

Workman ready to drop tool into concrete. Electric generator is on ground.

See the snarl of cable between tool and generator. Tiger Brand is made for this treatment.

AMERICAN STEEL & WIRE DIVISION, UNITED STATES STEEL, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA., SOUTHERN DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS TIGER BRAND ELECTRICAL WIRE & CABLE

A STANDARD TIGER BRAND CABLE FOR EVERY SPECIAL JOB

- asbestos wire and cable
- mold cured portable cord
- shovel & dredge cable
- paper & lead cable
- varnished cambric cable
- interlocked armor cable
- special purpose wire & cable
- aerial, underground and submarine cable

USS

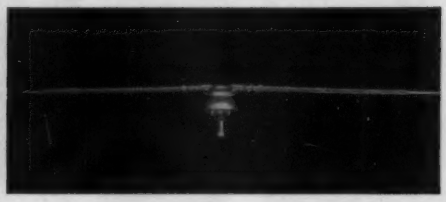
UNITED STATES STEEL

TURN MINUTES
INTO YEARS OF Protection
at the
vital points of overhead conductors

Fine FANNER
SUPERFORMED ARMOR RODS
are easily applied . . . provide positive full-length grip and absolute uniformity of application

Fine Fanner SUPERFORMED Armor Rods offer the economical way for positive, lasting protection of overhead transmission and distribution lines. Their INSTALLED cost is so small compared with the service failures they prevent, it pays to install them at all points where vibration damage is likely to occur.*

Armor rods are easy to apply.



Completed armor rod installation.

Whenever you need accessory items for overhead conductors you'll do far better by standardizing on fine Fanner SUPERFORMED products. Each product in the Fanner SUPERFORMED line is carefully engineered and accurately manufactured. Highest quality materials provide long service life. Special packaging insures safe delivery and protection in storage. With all their extra features, Fanner SUPERFORMED products cost no more than ordinary products.

Armor rods and other products in the SUPERFORMED line are fully described in current literature. Write today for your copy.

*Where spans are short and tensions low, use Fanner SUPERFORMED lineguards.

Licensed for use under patent No. 2,275,019.

Fine Fanner Superformed

THE FANNER MANUFACTURING CO.
Electrical Products Division
BROOKSIDE PARK • Established 1894 • CLEVELAND 9, OHIO
Telephone: SHadyside 1-6000

AGENTS AND DISTRIBUTORS IN PRINCIPAL CITIES

TAP ARMOR PLASTIC FANNGUARDS PATCH RODS FANNGRIPS

Gauges, Blades

(*Continued from page* 102)

clearance by measuring the axial distance from the shrouding around the rotor blade tips to the base of the outer stator blades. As conditions at the blade tips are severe—high velocity steam at 700F—a temperature-resistant probe is essential.

Rf Source Energizes

A typical mutual inductance probe contains two coplanar, coaxial coils wound on a dielectric core. An rf source, regulated with respect to the product of the frequency and current, energizes the primary coil. The ac voltage induced in the secondary coil depends on the distance from the probe to a nearby electrically conducting reference plate.

Suitable electronic circuitry detects and amplifies the output voltage from the secondary coil, and the amplified voltage is indicated on a meter calibrated to give the probe-to-surface measurement in inches or centimeters. The instrument detects very rapid displacement changes.

In measuring transverse motion of the shroud band, the energized primary winding induces voltages in two secondary coils covering separate halves of the primary winding area. These half windings are connected in series opposition. Thus there is no voltage output when the band around the blades is centered over the probe.

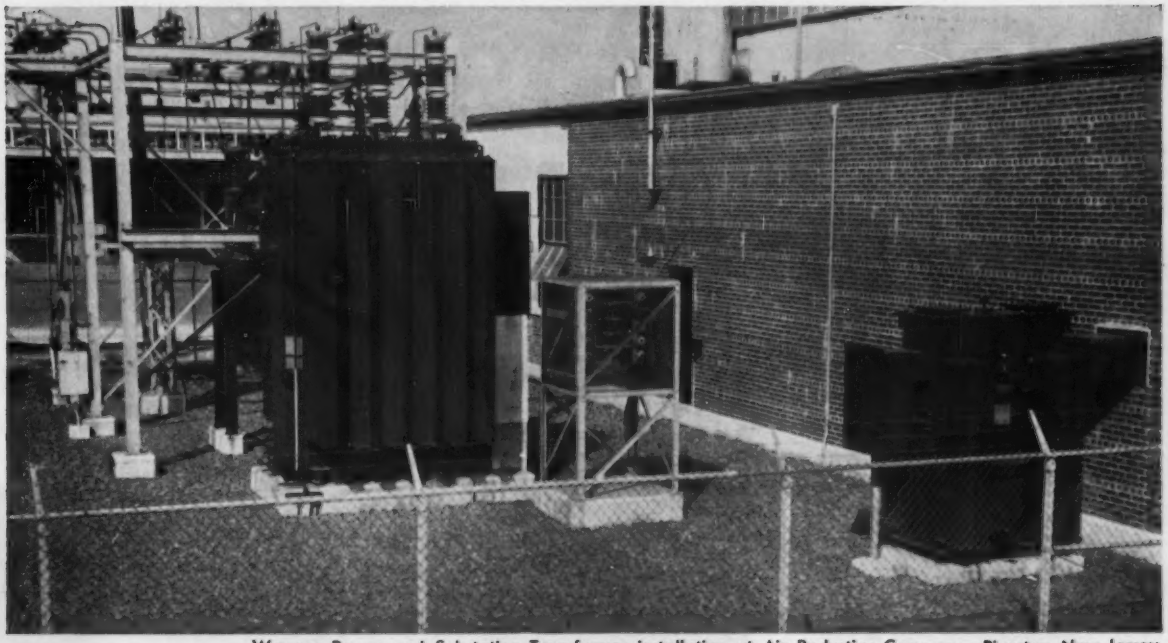
No Output Results

The band corresponds to the reference plate of the typical mutual inductance probe. Eddy currents induced in it as it approaches the coil assembly set up an opposing field that reduces the mutual inductance between windings. When the band is directly over the center of the probe, the inductance in each half winding is reduced by an equal amount, and no net output results.

When the band moves transversely, so that the half windings are unequally covered, the inductance of one coil increases, and the other decreases. Consequently the voltage output is nearly a linear function of the transverse motion away from the center of the probe.

A change in radial clearance—as

(*Continued on page* 110)



Wagner Power and Substation Transformer installation at Air Reduction Company—Riverton, New Jersey.

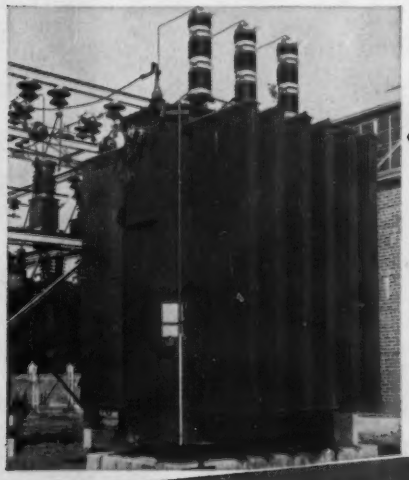
Taking raw materials from the air

The Air Reduction Sales Company manufactures liquid products direct from the atmosphere—products like oxygen, nitrogen, argon, and neon. In some cases, the liquids are then converted into gases for industrial and medical use.

Such scientific sleight-of-hand in transforming air into product is made possible on a mass-production basis only through the use of electricity . . . the source of power for all modern production.

Wherever electric power is used, Wagner Transformers efficiently and dependably handle their never-ending job of supplying proper voltages for every purpose. At Air Reduction's Riverton, New Jersey plant, this power is supplied through Wagner Transformers.

Let a skilled Wagner engineer discuss your transformer needs with you. Call the nearest of our 32 branch offices, or write us direct.



This 7500 kva Wagner Power Transformer supplies power for Air Reduction Company's Riverton, New Jersey plant.

The 1000 kva Wagner Substation Transformer steps down to 480 volts for motor circuits in the plant.

Wagner Electric Corporation
SERVING INDUSTRY SINCE 1891

WT57-4

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

Wagner Electric Corporation
6456 Plymouth Ave., St. Louis 14, Mo., U.S.A.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

"Heating in our switch was causing 'lights-out' shutdowns until we changed to cooler operating Fusetron Fuses"

Thomas Lavin, Building Engineer
Railway Exchange Building
Denver, Colorado

Mr. Lavin Continues:

"We had considerable trouble with heat developing in a lighting switch and causing fuse blows. It was very annoying having the lights go out so often—and having regular maintenance work interrupted to replace fuses.

"Checking with an ammeter we found the continued load to be 28 ampere. This indicated that 30 ampere fuses in use were the right size for safe protection. Nevertheless, the renewable fuses we had installed kept blowing.

"Evidently, what we needed were the same size fuses that would operate cooler to eliminate heating in the switch.

"At the suggestion of a salesman we tried 30 ampere Fusetron dual-element fuses. Our heating problem immediately disappeared. This was 7 or 8 months ago and we have had no trouble with the switch overheating—and our—'lights-out' shutdowns are a thing of the past."

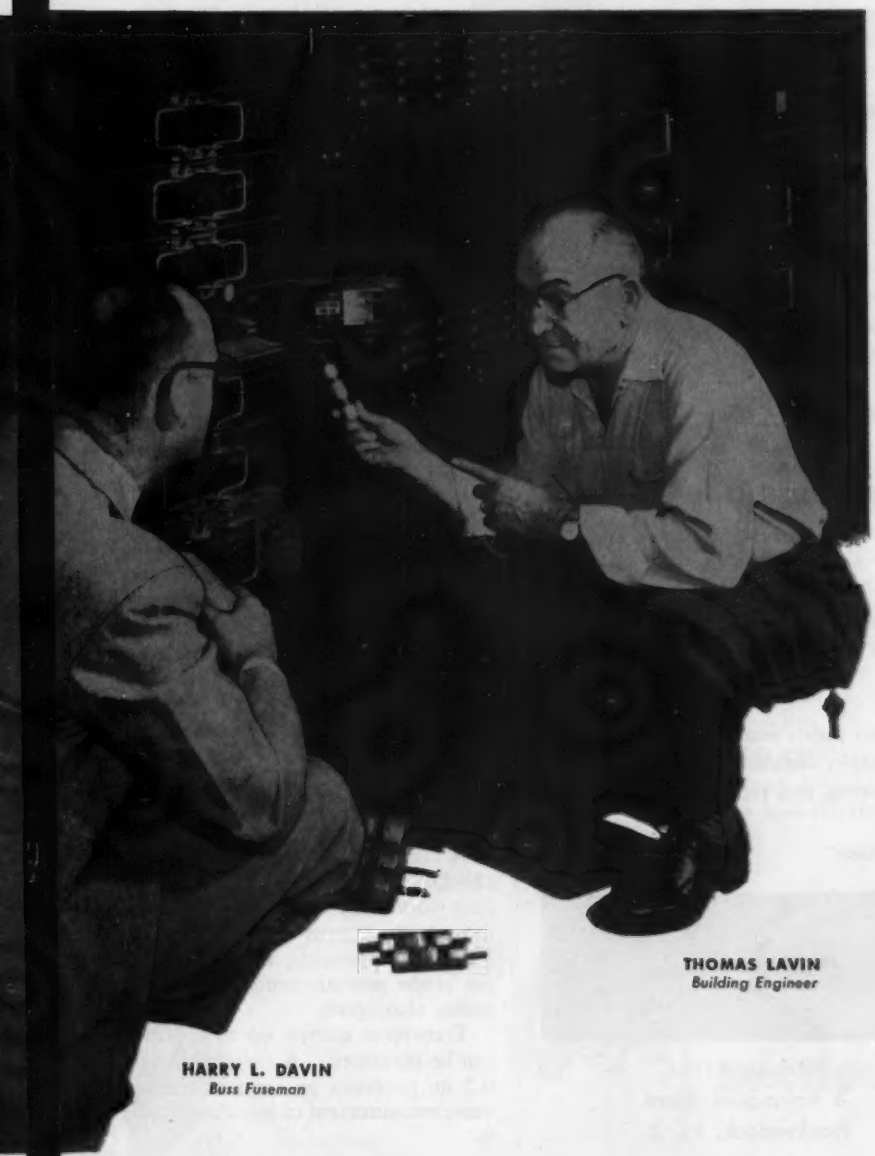
Here's why Fusetron Fuses protect against needless blows caused by excessive heating of panels and switches

Fuses, like other protective devices operate from heat created by the current flowing through them. Thus they produce some heat even in normal operation.

Sometimes the heat is not dissipated from switches and panels fast enough. This piled up heat over-heats fuses and reduces their carrying capacity. Then fuses often blow even though not loaded to their rated capacity.

A logical answer to this heating problem is the use of Fusetron fuses. Fusetron fuses produce less heat because they have less electrical resistance than ordinary fuses. For example, ordinary fuses have 55 to 117% greater resistance than Fusetron fuses in 250 volt sizes and up to 140% greater resistance for 600 volt sizes.

Since the lower resistance of Fusetron dual-element fuses means less generation of heat, switches and panels operate much cooler. This materially reduces or wipes out entirely useless shutdowns caused by fuses blowing due to overheating of panels and switches.



HARRY L. DAVIN
Buss Fuseman

THOMAS LAVIN
Building Engineer

Save time, trouble and money by using Fusetron dual-element Fuses.

THEY PROVIDE 10 POINT PROTECTION

1 High interrupting capacity—protect against heaviest short circuits. Have proven on tests to open safely on circuits set to deliver in excess of 100,000 amperes. **2** Protect against needless blows caused by excessive heating—lesser resistance results in cooler operation. **3** Protect against needless blows caused by harmless overloads. **4** Provide thermal protection—for panels and switches against damage from heating due to poor contact. **5** Protect against waste of space and money—permit use of proper size switches and panels. **6** Protect motors against burnout from overloads. **7** Give DOUBLE burnout protection to large motors—without extra cost. **8** Protect motors against burnout due to single phasing. **9** Make protection of small motors simple and inexpensive. **10** Protect coils, transformers and solenoids against burnout.

Write for bulletin FIS.

FOR LOADS ABOVE 600 AND UP TO 5000 AMPS. — USE BUSS Hi-Cap FUSES!

They have an interrupting capacity sufficient to handle any fault current regardless of system growth.

They can be coordinated with Fusetron fuses on feeder and branch circuits to limit fault outages to circuit of origin.

Write for bulletin HCS.

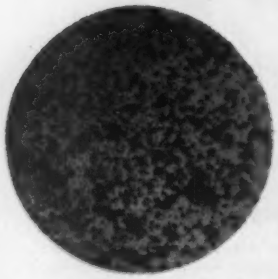
Play Safe! *install FUSETRON dual-element Fuses and BUSS Hi-Cap Fuses throughout entire Electrical System!*

BUSSMANN MFG. CO.
(Div. of McGraw Electric Co.)
University at Jefferson,
St. Louis 7, Mo

257

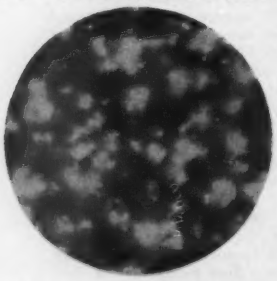
HOW SUBOX PAINTS ACTIVELY COMBAT CORROSION

Subox paints go far beyond the passive protection of inert paints. The chemically-active suboxide of lead in Subox paints actually works continuously to combat corrosion, as illustrated by these photomicrographs:



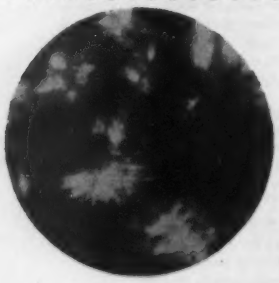
LEAD-SUBOXIDE PARTICLES

Lead-suboxide is a colloidal pigment which assures maximum penetration of a surface . . . packs to form a dense, impervious film. Two coats of Subox usually give the coverage of three of other paints . . . often, one coat of Subox is enough.



FIELD OF LEAD SOAPS

As soon as Subox is dry, lead-suboxide begins to react with the fatty acids of the vehicle to form insoluble lead soaps whose fibers bear metallic lead. These fibers intertwine to continuously build up a reinforcing film of protection.



FIBROUS STRUCTURE OF LEAD SOAPS

The fibrous film gradually strengthens and replaces the original vehicle film which otherwise would have become brittle and have largely lost its protective power and adhesion.

Subox paints are the only American paints made with lead-suboxide. They are economical to apply, endure for years and largely eliminate the need for scraping and repriming when repainting is required.

Write for the brochure "Subox Paints".

SUBOX PAINTS

Subox Inc.

Established 1924
3 Fairmount Plant
Hackensack, N. J.

Gauges Blades

(*Continued from page* 106)

happens when the band moves toward or away from the probe—changes the sensitivity of the probe and introduces error in the measurement. To measure axial motion independently of radial shift, a voltage is generated in the probe, which controls the amplitude of the exciting current. This voltage is proportional to the sensitivity for transverse motion, decreases as the radial clearance increases, and remains constant as the band moves transversely.

The probe is about 3 in. long, 2½ in. wide, and ¾-in. thick. With respect to the turbine, its length is axial, its width tangential, and its depth radial. The coil configuration is printed on a steatite plate, ⅛ in. thick, mounted at the top surface of the probe housing. The printed pattern of conductors is glazed to protect the silver from erosion by steam.

To minimize crossover connections, conductors are printed on the back as well as the front of the plate. Connections are made through small holes filled with conducting material. The outgoing leads are brought up through tubes fused into holes in the edge of the plate using a conducting joint compound. The tubes are compressed and spotwelded over the wires.

When turbine operation is normal, the probes may last several hundred hours. When the turbine is frequently subjected to severe transient conditions—such as sudden reversal of direction—the life of the probes may be as short as 30 hr. But this life is adequate, as the probes are used only for short test runs.

A few probe failures have occurred from cracking of the ceramic plate. These failures led to designing the supporting frame so that the plate is not subjected to distortion.

Accuracy of the indicator can be checked only indirectly. Rubbing pins worn away by the shroud band indicate clearances that agree with probe measurements, and independent probe measurements at various points also agree.

Transverse motion up to 0.4 in. can be measured. A radial shift of 0.2 in. produces an error in transverse measurement of less than 0.02 in.

When you have to

"reach" for low resistance—

A STEADY LOWERING of the water table has brought about a serious grounding situation in many parts of the country. The efficient functioning of protective devices on overhead lines depends on low-resistance grounds. With less moisture in the earth, large numbers of existing grounds are no longer adequate.

To solve this problem, many companies are carrying out extensive ground improvement programs, driving Copperweld* Sectional Ground Rods to depths of 30 or 40 feet and more. This simple, economical method has proved again and again to be highly effective, resulting in improved performance, safety and protection. And, with so much at stake, it pays to be sure by using "Copperweld"—the only Molten-Welded Ground Rod.

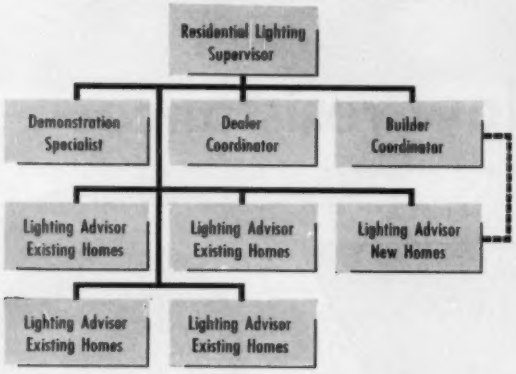
*Trade Mark

COPPERWELD STEEL COMPANY
WIRE AND CABLE DIVISION *Glassport, Pa.*
For Export: COPPERWELD STEEL INTERNATIONAL COMPANY, New York

. . . drive DEEP with Copperweld TRADE MARK sectional ground rods

The Home Lighting Team

(Recommended Organization To Serve 100,000 Customers)



Utility Lighting Teams sell . . . light by the 'roomful', as . . .

'Light for Living' Rounds Out 2nd Year

KG&E and MP&L find that coordinating all elements in their selling program, plus use of the 'Lighting Center' pushes their residential lighting load toward 10-year goal of additional 1,000 kwhr per test area customer

With the residential lighting load assuming increasing importance in helping to balance the rapid growth of summer air conditioning loads, the second-year results of the "Light for Living" programs at Kansas Gas & Electric Co and Mississippi Power & Light Co should be of great interest.

"Light for Living" was developed by Ebasco Services, Inc, in 1954. Its central idea—that lighting should be sold by the "roomful" or "houseful", rather then piecemeal, lamp by lamp or fixture by fixture—was proved highly feasible after the program was a year old (EW, Jan. 2, 1956, p 51). Another important consideration was that all elements should get in on the act. Everybody helps the sell—dealer, distributor, contractor, banker—all led by the utility.

How Far Have They Come?

How far have the utilities gone toward their long-range goal of light conditioning 50% of the homes in the test areas over a 10-year period, and in so doing add 1,000 kwhr per customer to their residential loads?

So far:

- Home builders have increased the number of valences, coves, fixtures and service outlets in the *new* homes they are building, increasing the connected load by 1.0 to 1.2 kw. Closet lights and garage lights over both sides of cars are now much more common. Outlets are installed along walls at 6-ft intervals in living areas.
- Construction standards have been set up by the utilities, and a certificate or plaque awarded when a new home meets them.
- Customer contacts have increased to more than 5 calls per utility home lighting adviser per working day, causing increased impact at the consumer level.
- More than 800 rooms and 25 homes in the *existing* home market were light conditioned, adding more than 4,000 ft of valences and 3,000 new fixtures.
- Fixture distributors and lamp dealers report customers are demanding higher quality lighting equipment, specifically *equipment that meets the utilities' light conditioning standards*. Unit volume of equipment sales has remained about equal to 1955 despite declines in new home sales, but dollar volume sales are up.
- Thirty watts per customer were added in new home lighting alone in 1956.
- One company's lighting team sold 1,095 kw of new lighting load in 1956 compared with 539.5 kw in 1955. The other company's team, working in a smaller market, sold 852.5 kw as against 288.1 kw for the same years.
- Total kwhr sales compared favorably with those in 1955, despite the 44% decline in home building. Sales in 1956 were 5,165,200 kwhr compared to 4,969,100 in 1955.

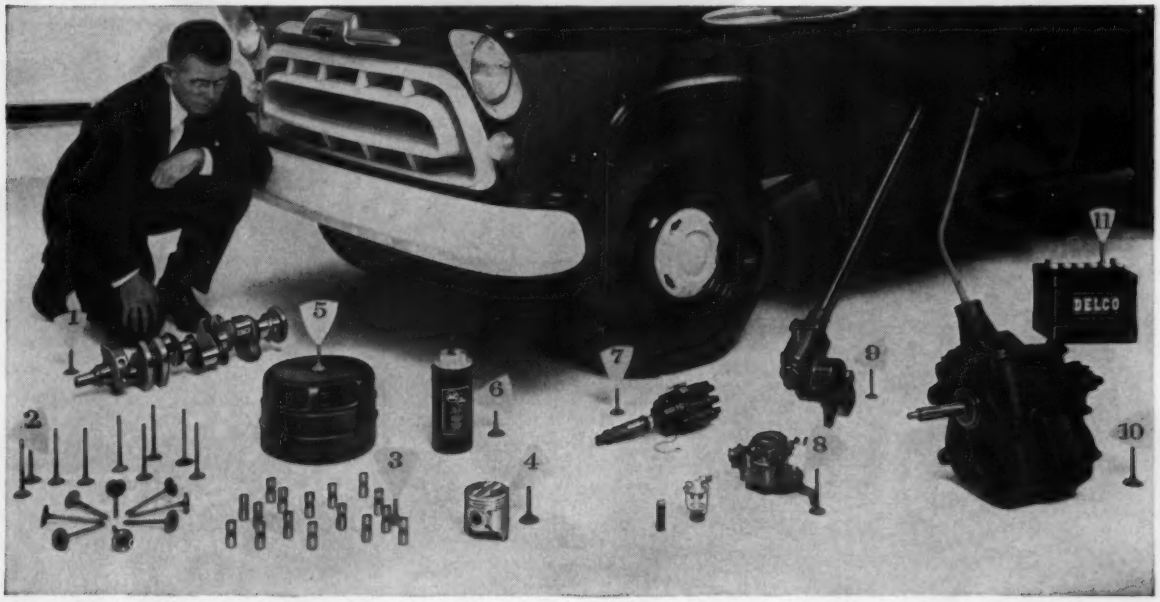
Lighting Center a Vital Link

Continuing tests point out that one of the most important parts of "Light for Living" is the Lighting Center, a retail establishment where the consumer can purchase all types of lighting equipment, get planning and decorating services, hire a wiring contractor, and get credit.

It should be noted that throughout the program, the utilities have concentrated on the middle 60% of the market, measured roughly by income. They feel that this group is the easiest to sell.

(*More Selling on page* 115)

LOW HAULING COSTS COME RIGHT FROM THE "HEART" OF A '57 CHEVY



Many of the things that make a Chevrolet truck more economical to run are seldom seen by the owner. They're hidden features, deep in the truck's design. Here are just a few of them, to prove a Chevy's engineered better and built better for bigger savings!

1. *Forged steel crankshaft*—It's extra sturdy, precision machined and balanced, the foundation for dependable, long-lasting power!

2. *Aldipped exhaust valves**—Special aluminum treatment on valve surface protects valves against pitting; engine wears less, costs you less to run!

3. *Hydraulic valve lifters*—for longer valve life in V8's, fewer engine repair jobs.

4. *Chevy V8 piston*—Thanks to *short-stroke* V8 engine design, this piston travels a shorter distance, wears less. Short-stroke efficiency aids fuel economy, too!

5. *Oil-bath air cleaner—standard* on all Chevrolet truck engines for added protection against dust and foreign matter that shorten engine life.

6. *High-capacity oil filters***—They remove dirt particles from Chevy engine oil to cut engine wear and maintenance.

7. *Easy-adjust distributor points*—You can adjust this new Chevy V8 distributor *with the engine running*; it's added insurance against costly down time.

8. *Multiple fuel filters*—For *clean* fuel, all Chevy engines have fuel filters in the carburetor and fuel tank; in addition, V8's provide an *extra* filter at the carburetor.

9. *Ball-Gear steering mechanism*—Inside this steering gear scores of polished steel balls virtually eliminate friction. Less friction means less wear, less maintenance!

10. *Rugged manual transmission*—Synchro-Mesh design eliminates the need for double-clutching, reduces costly wear. Gears are shot-peened for extra strength.

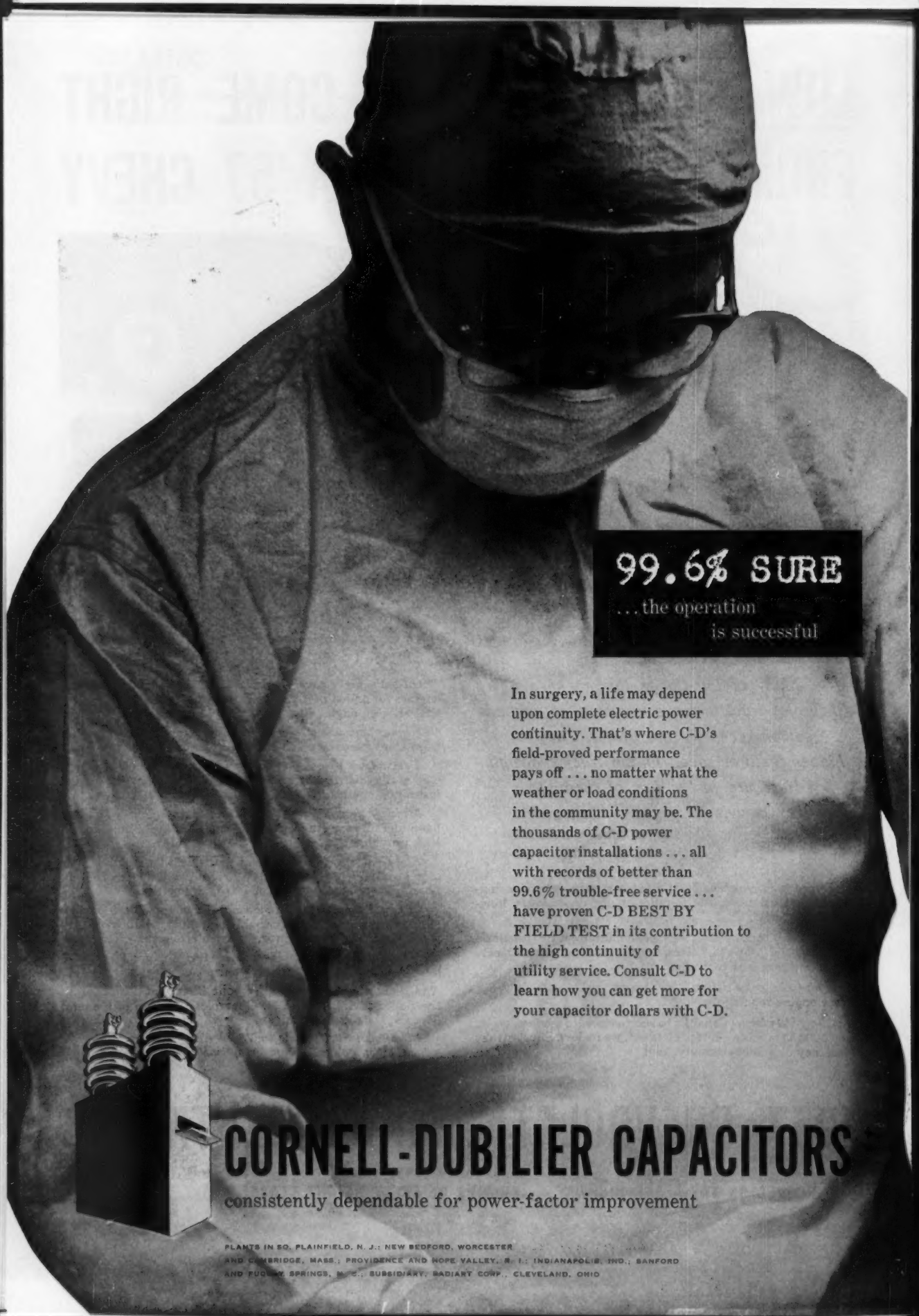
11. *12-volt battery*—provides sure starting, good ignition, long battery life in all Chevrolet trucks.

And there are many more! See your Chevrolet dealer for all the dollar-saving facts. . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

**On Thriftmaster 6, Trademaster V8.*
***Standard on V8's and Jobmaster, optional on Thriftmaster 6.*

1957 CHEVROLET TASK·FORCE TRUCKS

PROVED ON THE ALCAN HIGHWAY . . . CHAMPS OF EVERY WEIGHT CLASS! CHEVROLET


99.6% SURE
...the operation
is successful
In surgery, a life may depend upon complete electric power continuity. That's where C-D's field-proved performance pays off . . . no matter what the weather or load conditions in the community may be. The thousands of C-D power capacitor installations . . . all with records of better than 99.6% trouble-free service . . . have proven C-D BEST BY FIELD TEST in its contribution to the high continuity of utility service. Consult C-D to learn how you can get more for your capacitor dollars with C-D.
CORNELL-DUBILIER CAPACITORS
consistently dependable for power-factor improvement
PLANTS IN SO. PLAINFIELD, N. J.; NEW BEDFORD, WORCESTER AND CAMBRIDGE, MASS.; PROVIDENCE AND HOPE VALLEY, R. I.; INDIANAPOLIS, IND.; SANFORD AND FUQUAY SPRINGS, N. C.; SUBSIDIARY, RADIART CORP., CLEVELAND, OHIO

CORNELL-DUBILIER
power-factor
capacitors
give you better than 99.6%
trouble-free service*

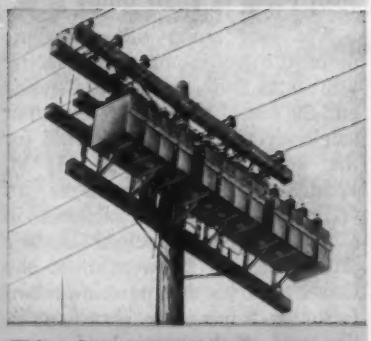
Low dielectric unit stress provides an extra margin of safety that results in the ability to withstand higher transient voltages. When you buy C-D, you buy premium quality at no extra cost.

C-D capacitors are impregnated and filled, in hermetically sealed containers with non-inflammable, non-explosive Dykanol. In addition, C-D's conservative engineering and design makes possible the use of special impregnants to fulfill even the most exacting requirements for sub-zero switching operations.

Extra strength wet process two piece porcelain terminals . . . one of the many important reasons why C-D capacitors can point to year after year of trouble-free service in coastal areas.

Another evidence of C-D's premium quality power capacitor service . . . at no extra cost . . . is the fact that C-D has *no* "Return Material Department". Most repairs are of such a minor nature that they are handled on an individual basis. This results in a prompt, personalized service impossible where the safety factor has been cut in favor of production, weight and size economies.

Why is it that only C-D power capacitors give you assurance of complete dependability?... because C-D's built-in safety factor results from the ultimate in tried and proven design levels coupled with conservative production techniques and rigorous quality control. For catalog write to Cornell-Dubilier Electric Corporation, South Plainfield, N. J.



This pole-mounted C-D Capacitor installation has been on the job for an Eastern utility since 1939 with little or no maintenance.

***This is an average based on reports from leading utilities using C-D capacitors. Many of these reports have shown 100% trouble-free service, and none lower than 98.9%.**

SELLING *(Continued)*

Salesman to Get the Word via Closed Circuit TV

The local sales executive clubs and chambers of commerce of 34 American and Canadian cities will sponsor two closed-circuit telecasts in the near future to demonstrate the latest, most effective selling techniques. The "Tele-Sell" shows, scheduled for Feb. 26 and Mar. 5, will run for two hours each and feature actual demonstrations rather than speeches or lectures.

Two themes will govern the telecasts: (1) how the salesman should handle himself, and (2) how the salesman should handle his customer.

Cities on the closed TV circuit include: Baltimore, Boston, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Columbus, Dallas, Dayton, Detroit, Erie, Ft. Lauderdale, Indianapolis, Jacksonville, Kansas City, Miami, Milwaukee, Minneapolis, Montreal, New York, Newark, Oklahoma City, Omaho, Philadelphia, Pittsburgh, Providence, Rochester, St. Louis, Syracuse, Toledo, Washington, Wichita and Wilmington.

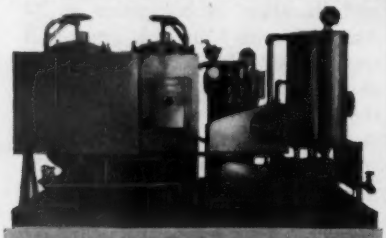
Cool Hens—More Eggs

Evaporative air cooling for poultry houses has proved effective in stimulating egg laying and reducing mortality of hens. Last summer during the period July 7-August 31, tests were conducted by Texas Power & Light Co at the Rylie Egg Ranch, Rylie, Texas. Temperatures averaged 15 F lower in the cooled poultry house compared to the uncooled house.

Egg laying showed a startling increase. 950 hens were placed in each of the two test houses. Those in the cooled house laid 18,950 eggs during the test period, while those without air-cooling produced only 10,803 eggs. Mortality rate was nine times greater in the uncooled house, where 18 hens died, as compared with only 2 in the cooled one.

(*More Selling on page* 116)

CFC PURIVAC®



FULLY
Dehydrates
Purifies
Degasifies
INSULATING OIL
IN ONE SAFE
OPERATION

You can rely on the safety, economy and performance of CFC Purivac — proved again and again by leading utilities — for treating insulating oils used in transformers, power transmission cables, switch gear, and circuit breakers. Purivac *fully* dehydrates, purifies and degasifies in one *safe* automatic operation. Purivac operates at a central reclaiming station or in the field *while electric equipment is in service.*

Some of the outstanding features of CFC Purivac are: centralized control panel; air-tight push buttons and wiring; 110 volt control circuits; fully guarded pump drives; automatically interlocked electrical system—to maintain oil level in transformer, to guarantee full spray vacuum treatment of delivered oil, and to insure against excessive localized heating. With Purivac, all manual lifting is eliminated.

A Commercial Filters Engineer will be glad to demonstrate the advantages of Purivac. Write for technical literature to Department EW.

COMMERCIAL FILTERS
CORPORATION
MELROSE 76, MASSACHUSETTS

Plants in Melrose, Massachusetts and Lebanon, Indiana

Air Conditioned Sidewalk

Texas has done it again! North Towne Plaza, one of San Antonio's newest shoping areas, has air conditioned its 16-ft wide sidewalks. The plaza's shopping facilities are similar to old open-air bazaars in which merchants spread their wares on stalls before large sheds and shoppers wandered from stall to stall or through open doors from shop to shop. The sidewalk is roofed over and enclosed on the outside with glass panels. Electric eyes operate doors at both ends and in the middle.

Store owners have praised the air conditioned sidewalk highly. All leave their doors open, and they report that this leads to an increase in store traffic which, in turn, is reflected in sales.

The walk is air conditioned by three 7½-hp Carrier Corp Weathermaker units installed in the adobe brick closets. The estimated cost of operating the air conditioning is reported at approximately $150 a month.

H & C BRIEFS

Heat Pump to Boost Utility Sales

The heat pump will contribute more to the economy of the electric utilities as a direct result of its sales and the use of power than any other single electric item that is sold for the home, according to H. M. Brundage, general manager of GE's Weathertron Department in a recent speech before electric utility officials. He went on to say that it will be the most important factor in helping the electric utilities level off the power load curves between the high peaks of summer and winter months.

Heat Pumps Go to Church

When the heating plant in St. Joseph Jesuit Church in Mobile, Ala., needed replacement recently, heat pumps provided the answer. Nine GE Weathertron units were installed in the crawl space under the building, reportedly providing physical comfort in all kinds of weather.

Portland Gets Heat Assn

Portland, Oregon, has a new member in its commercial family. The Portland Electric Heat Dealers Association, Inc, was formed there recently. Membership is 9 heat dealers, with a potential of 26 more.

The purposes of the organization, are as follows: To promote electrical heat, revive public confidence in the industry, establish good public relations, and bind together all industry factions.

(More Selling on page 118)

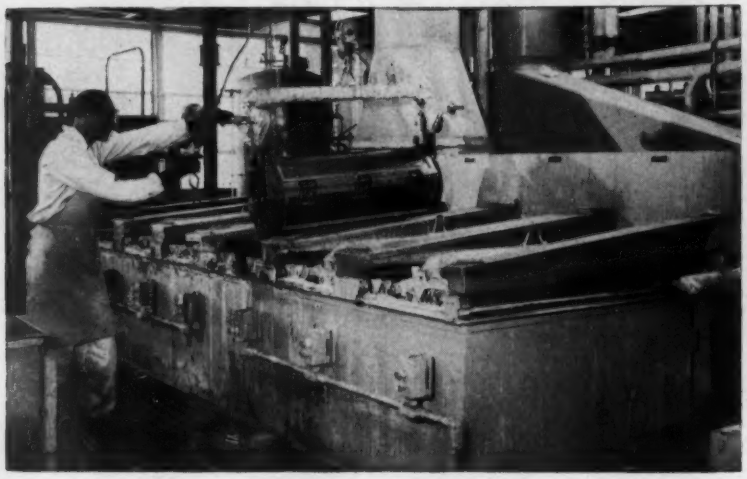
do rusty conduit threads cost more?

NO DOUBT ABOUT IT . . SO PITTSBURGH STANDARD CONDUIT THREADS ARE HOT-DIP GALVANIZED

Cost for rigid steel conduit must be measured by both purchase price *and* labor cost for putting the conduit in place. If workmen's time must be spent in chasing rust from threads, then you pay more—make less on the job. That's the reason Pittsburgh Standard gives you hot-dip galvanized threads on hot-dip galvanized conduit *on every size through 6-inches*. And because Pittsburgh Standard owns the world's most modern conduit mill, these hot-dip galvanized threads come to you *at absolutely no extra cost*. This is a major advance—company after company is rewriting specifications to call for Pittsburgh Standard Conduit. Available from your Pittsburgh Standard wholesaler, or write *Pittsburgh Standard Conduit Co., 61 Bridge St., Pittsburgh 23, Pa.*

PLANTS AT MORRISVILLE & ETNA, PA.

RIGID STEEL CONDUIT • ELECTRICAL METALLIC TUBING • ELBOWS • COUPLINGS • FITTINGS



Metallic Rectifiers Feed Plating Tank

Germanium rectifiers with 93% efficiency supply dc to zinc plate telephone parts in this tank at Western Electric Co, Indianapolis. Rated 5,000 amp each at 22 v, rectifiers replace M-g set, take extra load needed for expansion. Hermetic, fume-resistant units have closed cooling system, no moving parts except fans and pumps. Efficiency, low maintenance outweighed slightly higher first cost in selection.

Air Conditioning Spurs Hosiery Output

Maintenance dropped, overtime vanished, and production shot up 29% after John Hardy & Son, Inc, put air conditioning in their Pulaski, Tenn., plant. On a typical pre-installation day, the seaming department turned out 2700 pairs of hose. One week later, with the air conditioning installed and going, their output was 5328 pairs. And other departments showed the same results. In some cases, piece-work rates increased by 33%. Now plant workdays have been shortened, Saturday work has stopped, and overtime costs have been eliminated.

In the "bad old days" maintenance costs were high. The plant needed a full-time maintenance man on each of its three shifts, machines required constant adjusting. Knitting machines are 57-ft long, their needles have a clearance of only 0.002 inches. A 3-degree temperature variation and a 3% humidity change can throw out all these clearances, jamming the machines and tying up production. With the controlled temperature and humidity, the company's maintenance costs have plummeted 80% below the old figure. Moreover, because the room air is filtered and cleaner, the machines no longer need their old semi-annual cleaning.

The new air conditioning equipment consists of four, packaged 15-ton, water-cooled units, tied into two duct systems that extend the entire length of the plant. The same ductwork is used for heating. A thermostat and a humidstat, controlling one unit on each duct system, permit moisture removal in the in-between seasons. Under these conditions, re-heat is used to control the building temperature. In the winter, a spray-type humidifier with atomizer nozzles adds moisture to the air as necessary.

Total cost of the units was about $10,000 depreciated at 10%. Operating expenses, including power, run about $54.30 per month.

INDUSTRIAL BRIEFS

Production and candlepower went up together when the Publix Shirt Corp., of Mechanicsburg, Pa., put in a new fluorescent lighting system. Operators top stitching yokes on black, red, and khaki shirts now have 45 ft-c at the needle point. To test the new lighting, piece-rate earnings of two experienced operators were studied for three weeks before and after the installation without their knowledge. Average earnings for the first rose from $1.24 per hr to $1.40 per hr; earnings for the second from $1.14 to $1.20 per hr. Profits under the improved system were conservatively set at 5%. The company is now considering relighting the entire plant. The installation uses 4-ft units, each holding two 40-w, rapid start lamps, with a 10% upward component. Brent Shunk, Power Sales Engineer, Pennsylvania Power & Light Co., Harrisburg, Pa.

Brazed brass and steel parts for fire extinguishers are rolling off the line faster and with fewer rejects since the Lee-der Mfg., Baltimore, Md., installed their high frequency induction brazer. The 22-kw unit can handle even the largest, heavy gauge pieces in about 2½ minutes. Although each part is tested under a 600-lb hydrostatic pressure, rejects are few. The water cooled heating coils can be adapted to a variety of work. Once the start button is pressed the process runs automatically. L. A. Dobl, Industrial Power Sales Representative, Baltimore Gas & Electric Co., Baltimore, Md.

Prolonged motor life at the New York & Pennsylvania Co's paper mill in Johnsonburg, Pa., is the result of nearly 200 new, 600-w tubular heaters. Motors no longer have to be grounded or rechecked after a prolonged shutdown. Before heaters were installed, unusual moisture conditions were a constant threat to motors and switchgear. Installed along the ends and sides of approximately 100 motors, the 230-v heaters keep them dry, reduce failures sharply. W. F. Hutchins, Power Engineer, West Penn Power Co., Ridgeway, Pa.

Aluminum, too: This medium-weight Hub-Rak in the 3-wire, 8-inch spacing size, with non-extended back, comes in tough, light weight, heat treated aluminum alloy, offering greatly increased life, required strength, complete corrosion resistance, and permanent maintenance of its bright, clean appearance. Ask for Number AL-1738.

HUB-RAKS meet all your line construction needs

Whether you require light, medium or heavy secondary racks, Hub-Raks offer you important, money-saving advantages. For instance, forged steel points provide greater strength, with even stress distribution. That's because they are permanently aligned and riveted to the back plate. Mounting slots on the back are located to give you the greatest freedom in placing attachment bolts.

You can specify extended or non-extended backs based on your own preference in installation. Extended back styles are usually attached through the top and bottom mounting slots. If mounting bolts are desired directly back of the insulators for maximum holding strength, non-extended back style is preferred. Racks are mounted to the pole as received, less insulators. Mounting bolts will clear the insulator bolt without removing it. No. 355 or No. 455 Hubbard spool type insulators are added after installation.

There's a Hubbard extension bracket to work right with the Hub-Rak when you require it. Pressed from open hearth steel, and double-dip galvanized for extra protection. Hubbard Extension Brackets are available with either flat or curved backs for wall or pole mounting.

Sold exclusively through Electrical Distributors.

HUBBARD AND COMPANY

6301 Butler Street, Pittsburgh 1, Pennsylvania
Chicago, Ill • Oakland, Calif. • Plano (Dallas), Texas

NEW EQUIPMENT

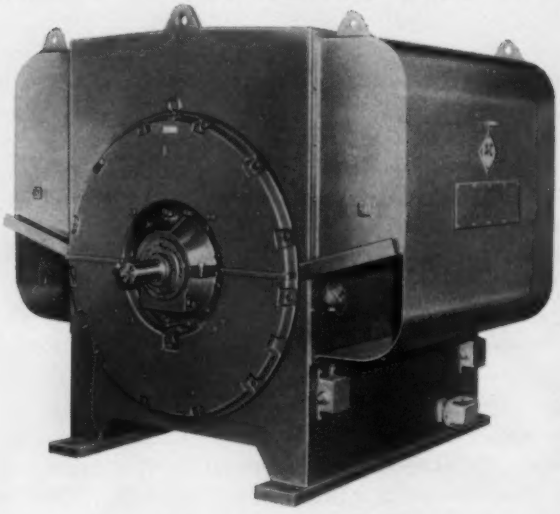
Watt-Hr Demand Meter

Type QSD watt-hour thermal demand meter uses a single-phase watt-hour unit to record kwhr and a logarithmic thermal unit for kva demand.

With a constant load, the demand unit is said to reach 90% of final value in 15 min. The thermal unit comprises two counterwound bimetal springs, one of which is heated from the secondaries of two current transformers. Primaries make up the series winding of the watt-hour unit, spring temperature varies with load current.

The QSD is rated 240 v, 15 amp, 60 cps, 3-wire, single-phase for a maximum demand of 24 kva. All components are reported to have an insulation level of 10 kv withstand-impulse voltage.

Westinghouse Electric Corp., Box 2276, Pittsburgh, Pa.



Outdoor Motors

Type FOD weather-protected, squirrel cage induction motors, 250 hp and up, are available for non-hazardous outdoor uses. Removable, screened air ducts are said to minimize entrance of moisture and particles and to reduce effects of high winds.

Pre-wound stator assembly is removable. Capsule-mounted sleeve bearings are used for direct-connected service. Cartridge-mounted anti-friction bearings are available for speeds to 1800 rpm. Sleeve-bearing motors have access holes for air gap measurement. Immersion type space heaters are standard.

Successful uses in power plant auxiliary drives, cooling towers and general pumping are reported.

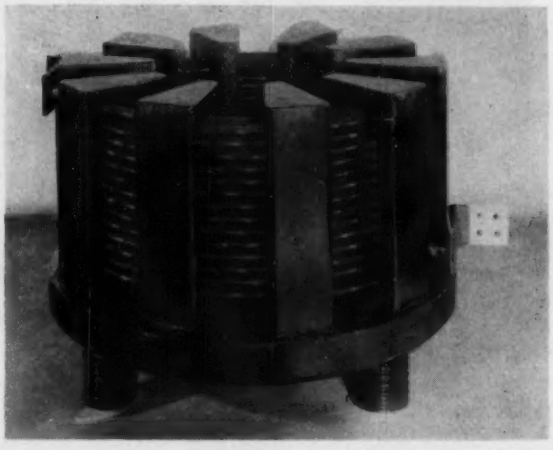
Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

Current Limiting Reactors

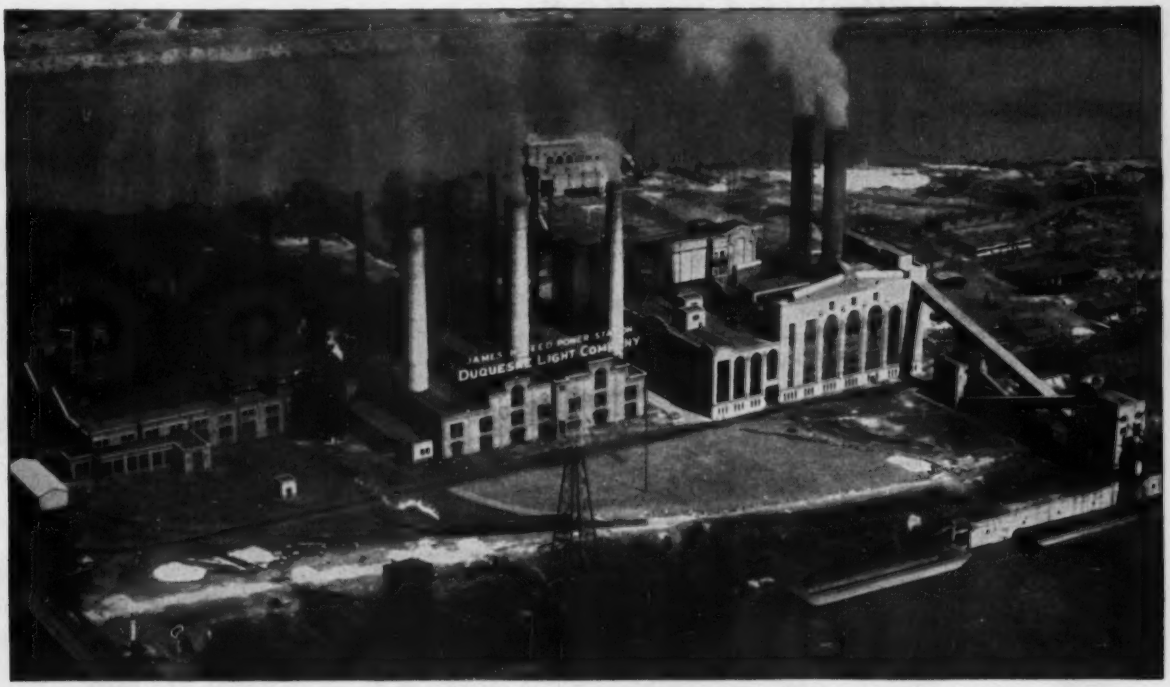
These RM (repetitive manufactured), current limiting reactors are designed to be used with standard 1,200 and 2,000-amp switchgear.

Voltage classes of 5 and 15 kv, single-phase or 3-phase, are available for indoor and outdoor use. The units have "cast-in-concrete" construction and aluminum conductors. Blade-type terminals may be copper or aluminum, depending on user's bus.

General Electric Co., Schenectady 5, N. Y.



(More New Equipment on page 124)



Air view of Duquesne Light Company's Brunot Island Plant, where all primary network cables are jacketed with Du Pont neoprene over lead. Resistance to soil acids made neoprene a natural choice for this underground installation.

AT DUQUESNE LIGHT COMPANY'S BRUNOT ISLAND PLANT

13 primary circuits to downtown Pittsburgh protected with neoprene jacketing

Routine inspection finds neoprene-jacketed cable in perfect condition. Water level in manhole at Brunot Island runs up to five feet in depth—but neoprene's resistance to acid and moisture assures proper protection.

Severe electrolytic corrosion, caused by Ohio River water in cinder fill, led to numerous failures in lead-jacketed primary network cables at the Brunot Island generating plant of Duquesne Light Company. To solve this problem, Duquesne has replaced all thirteen cables with neoprene-over-lead Type H cable.

Approximately nine miles of 11 KV and 22 KV shielded cable have been installed since the change to neoprene eight years ago. Duquesne relies on neoprene's durability and resistance to soil acids for long-term cable protection against electrolytic attack. Remember, too, neoprene can be used *above* ground with equally good results. It resists sunlight and weathering . . . withstands oil, grease and most chemicals. And neoprene's lasting resilience and flexibility make installation easier *anywhere*.

Get all the facts about neoprene-jacketed cable from your supplier. It's available in voltage ratings to meet your requirements.

NEOPRENE

The rubber made by Du Pont since 1932

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

FREE! THE NEOPRENE NOTEBOOK. Every issue contains interesting stories about products made with neoprene. Actual case histories give you the facts about neoprene's longer service life. Clip coupon to get on the mailing list. E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Dept. EW-2, Wilmington 98, Delaware.

*Name*_____ *Position*_____

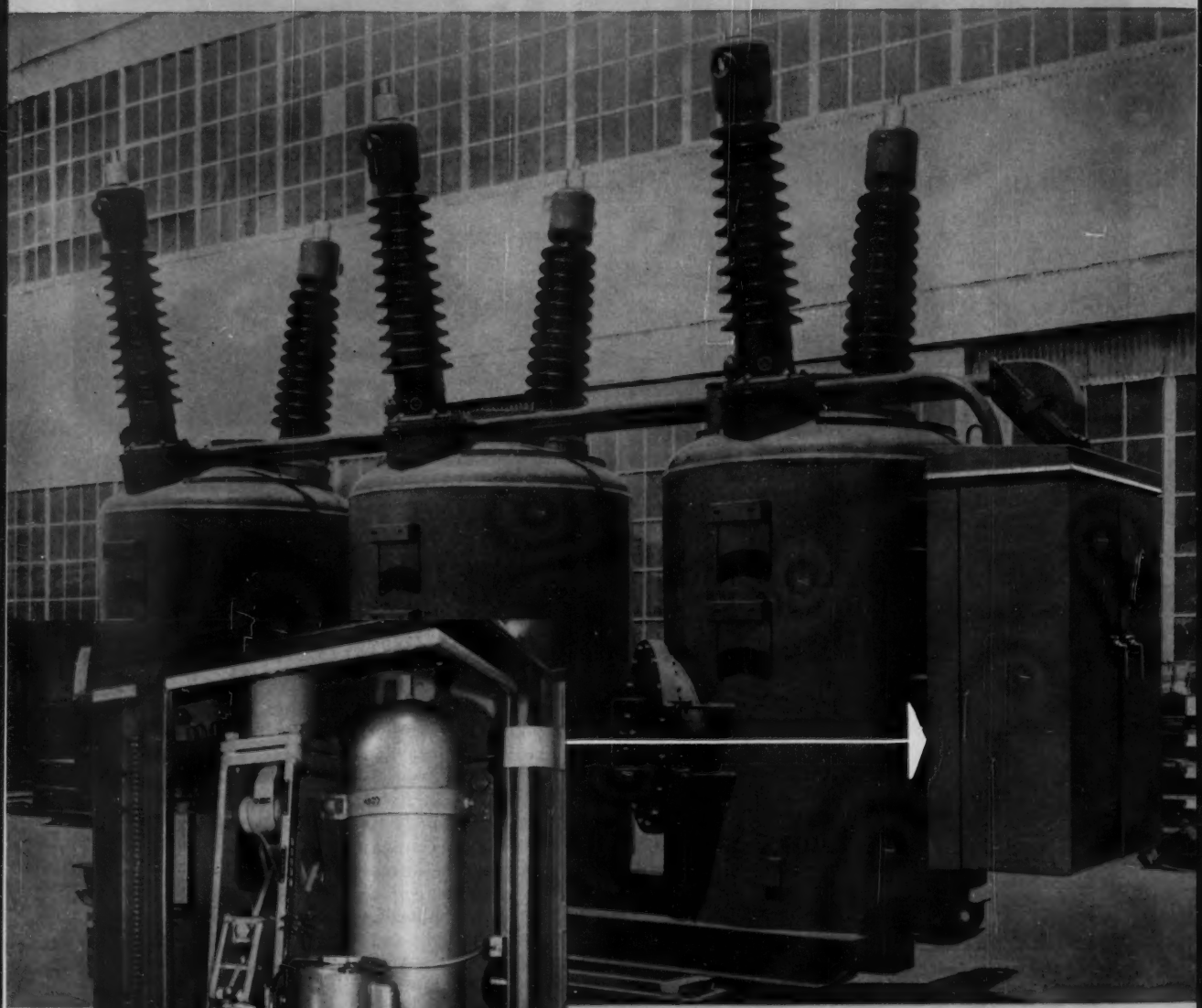
*Firm*_____

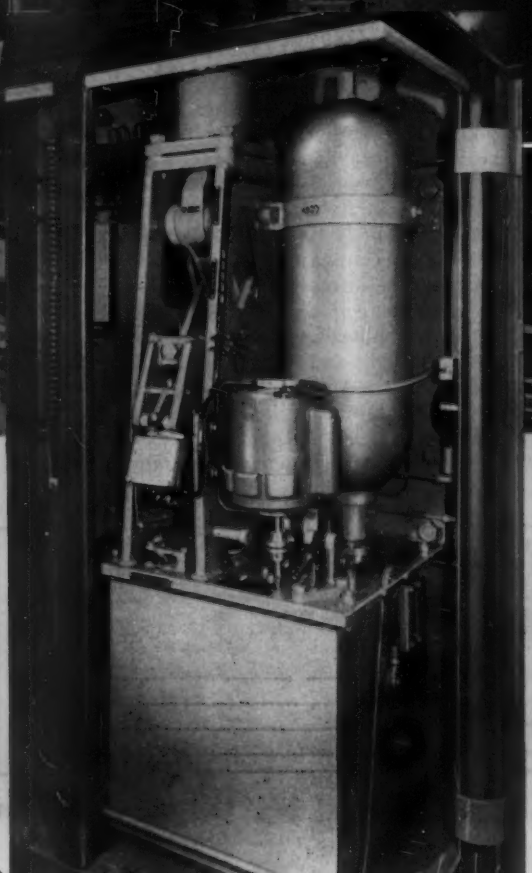
*Address*_____

*City*_____ *State*_____

Federal Pacific's

HYDRAULIC





Advantages of FEDERAL PACIFIC'S Type OA Operator

- Safe, Dependable Operation
- Quick Response
- Smooth, Shock-Free Performance
- Freedom From Corrosion
- Multiple Reclosings
- 100% Trip-Free Under all Conditions

For further details...write:

PACIFIC SWITCHGEAR DIVISION

5815 Third St., San Francisco, Calif.

Operating Mechanism

provides smooth, safe, dependable operation under all conditions!

A pioneer in the application of hydraulic principles for more efficient circuit breaker operation—Federal Pacific proved that quicker responsiveness could be obtained and smooth, shock-proof, dependable performance achieved through the use of a *Hydraulic* operating mechanism.

The type OA hydraulic operator, now standard equipment on most Federal Pacific Oil Circuit Breakers, climaxes an extensive development and improvement program in the use of hydraulics over a period of many years.

It is thoroughly tested and proved...and provides maximum freedom from operating trouble while insuring 100% trip-free performance under all conditions.

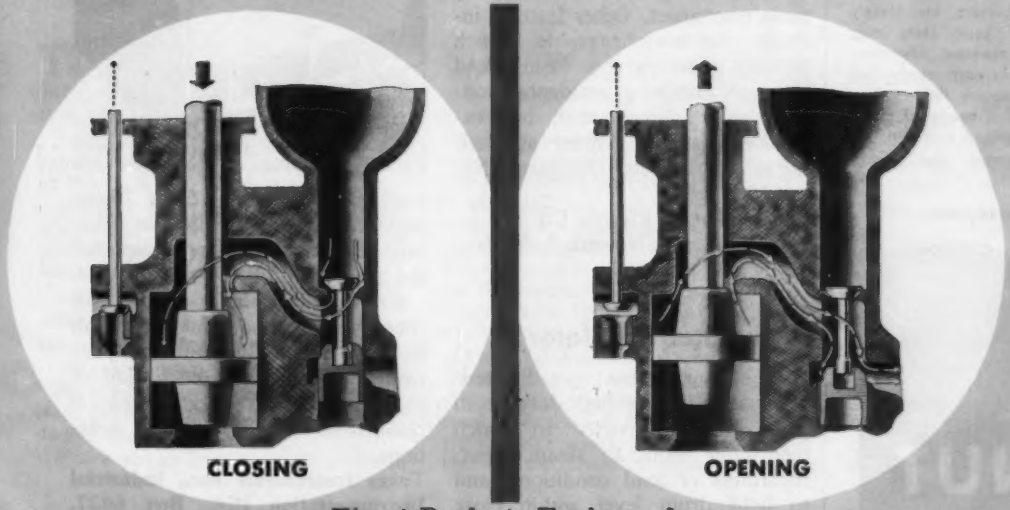
WHY HYDRAULICS ASSURE TOP PERFORMANCE

1. INELASTICITY OF HYDRAULIC FLUIDS PROVIDES INSTANT RESPONSE...the type OA operator, a closed hydraulic system, takes full advantage of this principle to provide immediate stopping or starting action. This permits rapid change in direction in breaker operation during a trip-free action.

2. HYDRAULIC COMPONENTS PERMIT PRECISE MOTION CONTROL...result in smooth performance. Hydraulic damping effect and dash pot action on both ends of the power piston stroke completely eliminate all overtravel. The ease with which opening and closing operations are effected marks a major design achievement.

3. HYDRAULIC FLUIDS ARE NON-CORROSIVE AND ANTI-SLUDGING...because of this, a long uninterrupted operating life without maintenance is assured. The closed hydraulic system prevents condensation, thus eliminating frequent servicing. As a result, complete safety and uniform operation is maintained...and maintenance minimized.

4. UNEQUALED TRIP-FREE ACTION UNDER ALL CONDITIONS...Hydraulic loading of trip latch permits trip-free performance throughout the entire closing operation and prevents latch chatter. Positive control between breaker and mechanism exists at all times.



Finest Products Engineered

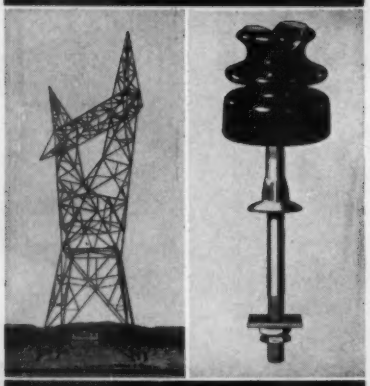
FEDERAL PACIFIC ELECTRIC

COMPANY

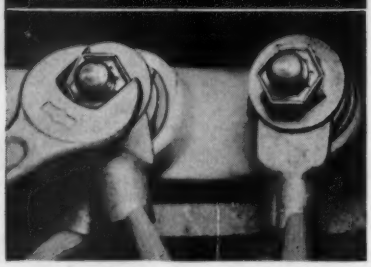
Main Office: 50 Paris Street, Newark 1, N. J.

Plants at Newark, N. J.; Long Island City, N. Y.; Cleveland, Ohio; St. Louis, Mo.; Dallas County, Texas; Scranton, Pa.; Los Angeles, Calif.; San Francisco, Calif.; Santa Clara, Calif.; Emeryville, Calif.; Affiliated Plant, Toronto, Canada.

Assemblies stay tight!



Connections stay tight!



—when locked with

PALNUT LOCK NUTS

FOR years, PALNUTS have been the standard lock nuts of the utility industry—on steel towers, wood pole hardware, connectors, disconnects, switches, fittings, transformers, etc. Here's why: PALNUT Lock Nuts stay tight under severest vibration, are very low in cost, apply fast and easily, require little space. Available in full range of sizes, in plain, Parkerized and Hot Dip Galvanized steel; also silicon bronze.

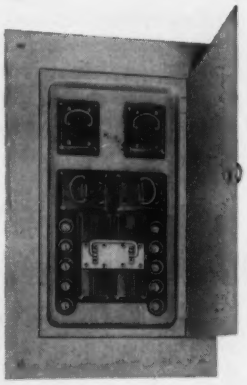
Samples and literature on request.

THE PALNUT COMPANY
51 Glen Road
Mountainside, N. J.
Subsidiary of United-Carr Fastener Corp.

PALNUT
TRADE MARK
LOCK NUTS
for quick, secure fastening at low cost

Glove Powder

A medicated powder for linemen's gloves, the Lineman's Friend, is said to prevent stickiness and to safeguard against skin infections caused by bacteria and fungi. Marketed in an unbreakable plastic squeeze-bottle, the powder can be sprayed directly into the glove.
Skarshaug Testing Laboratory, 3004 Lincoln Way, Ames, Iowa.



AC Main Switch

This fusible ac main switch is said to provide adequate protection for 240-v home appliances and branch circuits. The unit is equipped with 100-amp main disconnect for control of two 60-amp, 240-v pullouts; two 30-amp, 240-v pullouts; and 10 plug-fuse branch circuits.

Installation is said to be simplified by eliminating need for auxiliary main disconnect. Other features include: non-interchangeable branch pullouts to prevent over-fusing; dead front to eliminate accidental contact; split solid neutral; bus extension lugs for simpler subfeeding to other panels. Designated No. 14610.
Federal Pacific Electric Co
50 Paris Street, Newark 1, N. J.

Feed-water Regulator

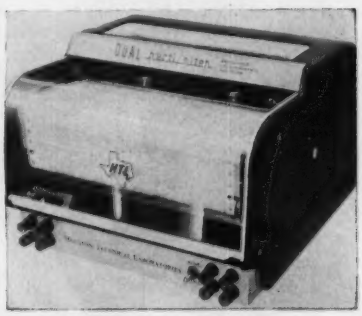
A balanced flow type P feed-water regulator for high duty steam generators is reported to match feed-water input to steam input, regardless of load conditions, and to hold drum level within close limits despite changes in load or feed-water pressure.

Steam flow and feed-water flow information is fed through separate differential transmitters to a balancing relay. A pressure-compensated pilot feeds the drum-level impulse to the same relay. This relay may be biased to favor any of the three factors or may be operated on a 1:1 basis.

According to the manufacturer, output ranges of the differential transmitters may be adjusted to give a rising, falling, or practically constant drum water-level characteristic. The system can be equipped with either diaphragm or piston-operated valves, having rectangular, characteristic-V, sleeve, or bevel-seated ports. The feed valve may be operated either from a local or remote point.
Copes-Vulcan Div., Blaw-Knox Co., Erie, Pa.

Chart Recorder

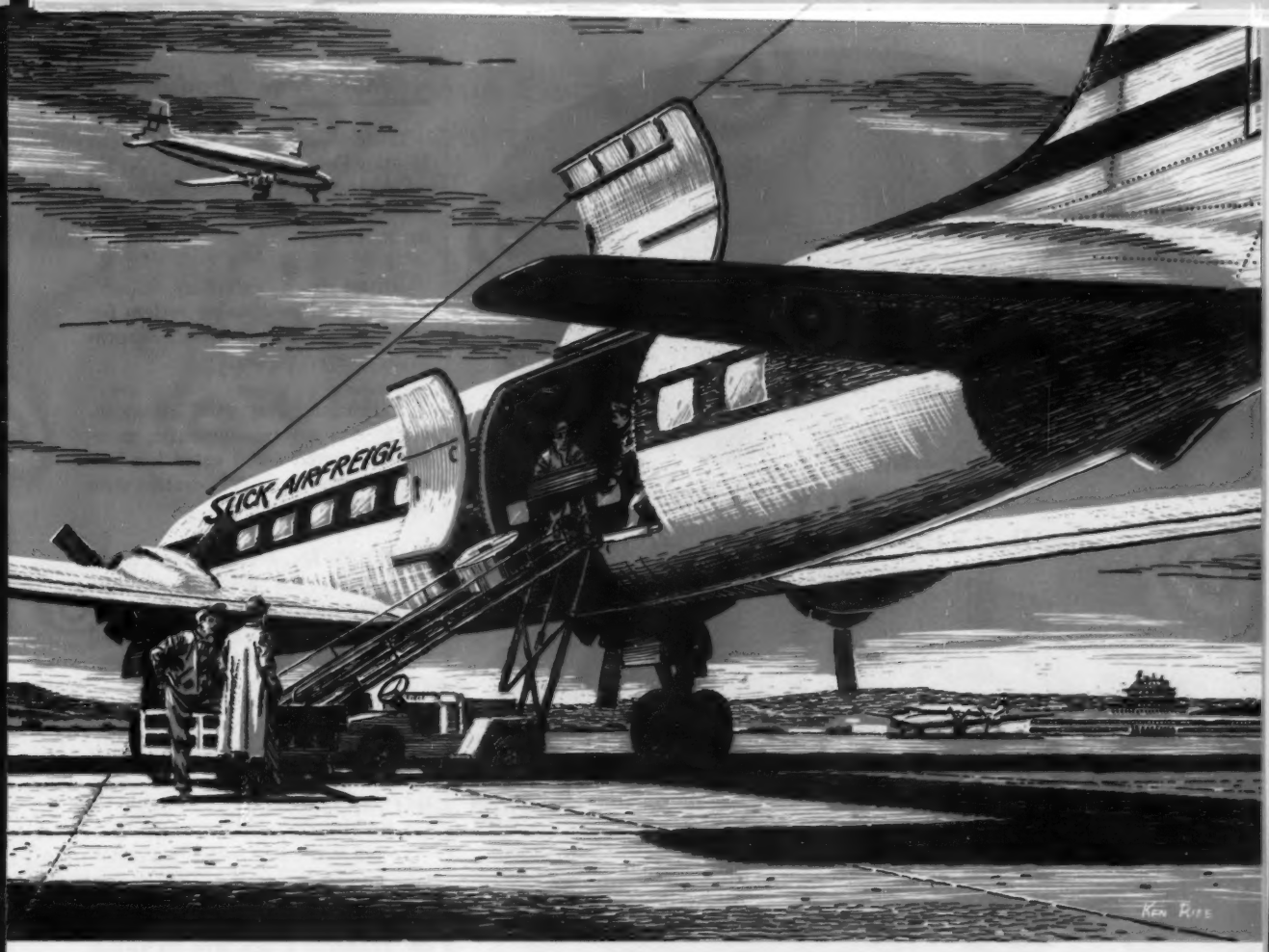
This Dual recti/riter, galvanometric, strip chart recorder reportedly is able to provide simultaneous, independent recordings of the true wave forms of two variables on a single time base. The two-channel, rectilinear writing instrument is said to have a full-scale rise time of 0.25 sec. The meter movement is



available with 1, 5, 10, or 25-ma input ratings for a full-scale (4½-in.) deflection and has a reported d-c accuracy of ± 1% of full scale.

Controls, terminals, and a 10-speed chart drive control are all front-mounted. Event marker pens can be mounted on each side of chart. "Writing desk" area is claimed to simplify manual notations.
Texas Instruments Inc., Industrial Instrumentation Div., Box 6027, Houston, Texas.

(More New Products on page 126)



"$175 freight for $160 worth of cable...

but the contractor'll save thousands!"

THAT'S almost the tail-end of a story that began three days earlier in New York when George Jacobs, Circle executive, answered his phone.

"George?" the receiver cracked urgently, "I'm in a jam. I need 2500 feet of RR cable in a hurry."

Another emergency, thought Jacobs resignedly. "Sure, but why all the excitement about 2500 feet of RR cable? We'll get it out in the morning."

"You can't," said the voice on the other end of the line anxiously. "It's a special, you'll have to make it up."

"What?" sputtered Jacobs excitedly. "You want me to tie up all that equipment for 2500 feet of RR cable? When do you need it?"

There was an uncomfortable pause on the other end and then, questioningly, "By the end of the week, George? Look, there's a hydro-electric project out here. Contractor on the job needs this wire to finish up. Somehow, 600 volt cable was supplied instead of the 1000 volt stuff the government specs called for."

The voice took time out for a breath. "This job's got to be finished fast. River water's rising and to top it off – there's a severe penalty clause for each day lost by the contractor. I've looked all over this state for 1000 volt, 12-1 stranded. I can't find any. Now it's up to you."

For a brief moment there was silence on the phone. Jacobs could hear the other's faint breathing some three thousand miles distant. Finally he said, "All right, we're wasting time. Let me get started. You'll have the cable in a week."

The "voice" was that of Leslie Gilbert, Portland Electric and Plumbing Co. The project was The Dalles Dam on the Columbia River. The sub-contractor was the Willamette Iron and Steel Co. The RR cable, incidentally, was made, shipped, and on the job in four days.

Why do we tell this story? Because it's another example of Circle service to customers. Giving this kind of service is basic policy at Circle – the result of a flexible organization out of sympathy with "red tape" and "stuffed shirts."

That is why working through a Circle distributor is always your best assurance of adequate supplies quickly and dependably delivered to the site. Specify Circle on your next job. Circle Wire and Cable Corp., 5500 Maspeth Avenue, Maspeth, New York. Dept. B2

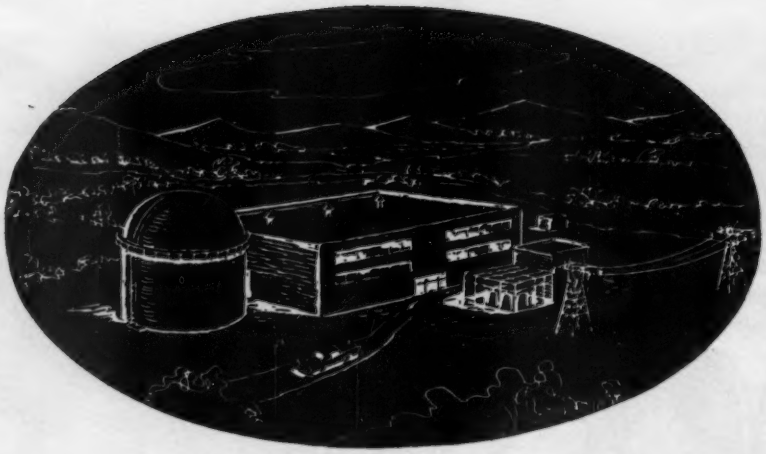
CIRCLE WIRE & CABLE
a subsidiary of CERRO DE PASCO CORPORATION

PLANTS: Maspeth and Hicksville, N.Y. SALES OFFICES: In all principal cities.

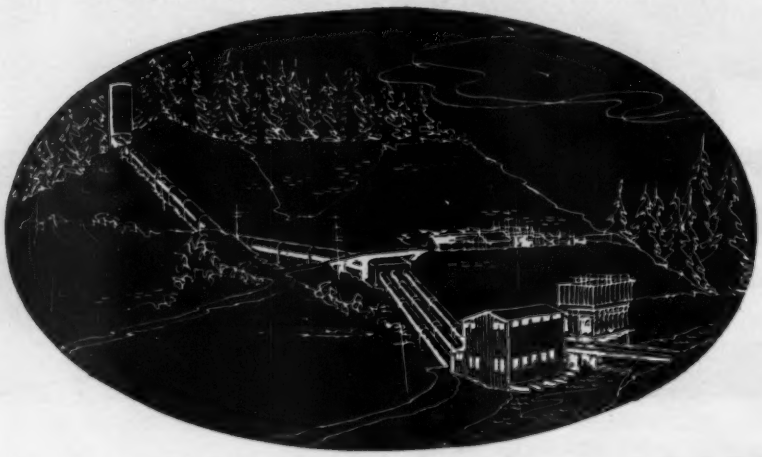
RUBBER COVERED WIRES & CABLES • VARNISHED CAMBRIC CABLES • PLASTIC INSULATED CABLES • NEOPRENE SHEATED CABLES

New Wiring Calculator — FREE!

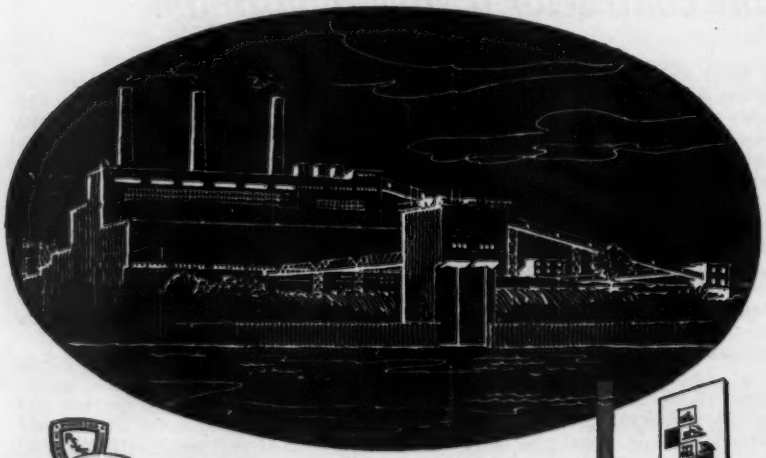
Send today for this handy, useful wiring aid. Gives conduit sizes, amperage capacities, and helpful motor running data.



PUTTING **POWER** INTO
YOUR EXPANDING PROGRAMS



ATOMIC, HYDRO and FOSSIL FUEL POWER PLANT DESIGN
FOR INDUSTRIALS and UTILITIES



55 YEARS

Pioneer Service & Engineering Co.

231 South La Salle Street • Chicago, Illinois

Send for our descriptive booklet, "Pioneering New Horizons" of these and other services.

More New Products

General Electric Co's Industrial Heating Dept, Schenectady 5, N. Y., offers a general purpose **industrial thermostat** with temperature ranges up to 700 F.

Bristol Co., Waterbury, Conn., has a **remote positioning system** for transmitting motion with appropriate output power.

Industrial Systems Co, Matawan, N. J., has a semi-automatic, manually operated aerial **extension ladder** designed for easy operation with safety.

Sensory, Inc, New Vernon, N. J., have developed **machine controls** that are said to feature compactness, and that can be installed or adapted within limited space conditions.

Tork Time Controls, Inc., Mount Vernon, N. Y., announces its series TA **defrosting time switches,** which work on time, pressure or temperature and reportedly are self-adjusting to provide commercial defrosting only when it is actually needed.

Farmer Electric Products Co, Inc, Newton Lower Falls, Mass., has produced a **synchronous switch** called a Model 3 Rototimer, for press control, magnetic counter actuation, shaft synchronization, and register control.

Western Insulated Wire Co, 2425 E. 30th Street, Los Angeles 58, Calif., have developed the following products:

Non-metallic-sheathed 600-v cable, type RR, two kinds. One suitable for direct burial in the earth, the other for use on raceways, ducts, or open wiring.

Shielded cords, "Bronco 66 Certified Type SO", made with 2, 3, or 4 conductors, sizes 8 through 10.

Control cables, "Bronco 66 Shielded", made with 5, 6, 7, 8, 10, or 12 color-coded conductors in sizes 18 through 14.

Special cords and cables, designated Type SO "P & R", designed to meet the severe operating conditions portable cords and cables face on reels and retractable machinery.

Portable control cables
Telephone distributing wire
Miner's lamp cord

Now! At Load Bonus Settings, General Electric's new ML-32 Voltage Regulator . . .

IGNORES SHORT CIRCUITS

By D. D. MacCarthy, Manager—
Feeder Voltage Regulator Engineering,
General Electric Company.

With the advent of Load Bonus, which G.E. introduced last year, some utilities asked what effect short circuits would have on regulators operating on higher current settings. Now we can give this quick and categorical answer:

General Electric ML-32 step regulators will withstand short-circuit currents up to 25 times the increased current at each Load Bonus setting for the time durations tabulated below.

Load Bonus, of course, means that, at ±5% regulation, G-E ML-32 single-phase step voltage regulators are suitable for currents up to 160% of rating, to a maximum of 400 amperes.

Now, the ML-32's extra short-circuit strength allows you to take full economic advantage of the 60% Load Bonus feature in applications where previously short-circuit capacity has been a limitation. Check the chart below. You will note that, in all cases, the ML-32 regulator will withstand short circuits long enough for circuit-interrupting devices to go into action.

For more information on the ML-32, write Section 423-16, General Electric Co., Schenectady 5, N. Y. or contact your General Electric sales office or agent.

Add load, maintain short-circuit capacity:

Regulating Range (Percent)	Load Bonus Current* (% of basic rated current)	Short-circuit Capacity** (% of basic rated current)	Short-circuit Duration (Seconds)
±10	100%	100% x 25	2.0
± 8¾	110%	110% x 25	1.6
± 7½	120%	120% x 25	1.4
± 6¼	135%	135% x 25	1.1
± 5	160%	160% x 25	0.8

*400 amperes maximum
**10,000 amperes maximum

ML-32 step regulators will withstand short-circuit currents up to 25 times the increased current at each Load Bonus setting for the time durations tabulated at left.

Progress Is Our Most Important Product

GENERAL ELECTRIC

pd

Decantation Principle

- reduces tube erosion
- separates large particles
- collects smaller particles

This basic P-D principle provides a unique system that separates large, high-carbon particles for refiring, and small flyash particles for disposal. And a decantation system can be installed for a very small additional cost, no additional area or pressure drop and very little added height. Features unique patented *PLENAFLO internal ducting.

Larger particles with sharp coke and cutting edges are the primary eroding elements of flue dust. These are primarily skimmed off before the dust-laden gas enters the tube and returned for refiring.

The Thermix Corporation are project engineers for Prat-Daniel. Contact them on this unique collector system. They will also be glad to give you information on P-D Standard Tubular Dust Collectors, Fan Stacks, F.D. and I.D. Fans and other components.

Write today for catalog. See the advantages of PLENAFLO.

*Trademark

Project Engineers
THE THERMIX CORPORATION
GREENWICH, CONN.
(Offices in 38 Principal Cities)
Canadian Affiliates: T. C. CHOWN, LTD., Montreal 25, Que.

Designers and Manufacturers
PRAT-DANIEL CORPORATION
SOUTH NORWALK, CONN.

POWER DIVISION: Tubular Dust Collectors, Forced Draft Fans, Air Preheaters, Induced Draft Fans, Fan Stacks

TECHNICAL LITERATURE

SERIES CAPACITORS—An "Application Guide for the Use of Series Capacitors with Distribution Transformers", by A. R. Milliken, discusses at some length the subject that its title implies. It includes advantages and savings to be obtained when line voltage regulation is achieved by using capacitors with distribution transformers. Available upon request from Electric Utilities Co, LaSalle, Ill.

COOLING TOWERS—The "Engineers Bibliography on the Design and Operation of Cooling Towers", a compilation of information on cooling towers and related information, is available from Texas Engineering Experiment Station, College Station, Texas.

WOOD POLES—Two publications, the first entitled "Electrical Resistance of Wood Poles", and the other "Practices in the Supplemental Field Treatment of Poles", have been published by United States Steel Creosote Research. They are available upon request from United States Steel Corp, 525 William Penn Center, Pittsburgh 30, Pa.

MOLYBDENUM DISULFIDE—Bulletin Cdb-5, a two page publication named 'Properties of Molybdenum Disulfide", covers the compound's physical, thermodynamic, electrical, magnetic, and chemical properties. It also discusses its preparation. May be obtained upon request to Climax Molybdenum Co, Dept L, 500 Fifth Ave, New York 36, N. Y.

EPOXY RESIN SYSTEMS—The physical and electrical properties of 25 different epoxy resin systems are given in a summary chart available upon request from Permacel Tape Corp, Dept ER, New Brunswick, N. J.

ARMOUR RESEARCH REPORT—The 52-page 1956 annual report of the Armour Research Foundation of Illinois Institute of Technology is now available. Marking its 20th year of service to industry and government, AFR conducted some 691 research programs totalling almost $12 million in the last year. For copies, write Armour Research Foundation, Illinois Institute of Technology, 35 W. 33rd Street, Chicago 16, Ill.

CATALOGS—BULLETINS

• **LINEMEN'S PROTECTIVE EQUIPMENT:** A 32-page illustrated brochure covers the linemen's protective clothing and equipment manufactured by Charleston Rubber Co, Stark Industrial Park, Charleston, S. C.

• **ARC WELDING MACHINE:** A new arc welding and accessory catalog is now available from Air Reduction Co, Inc, 150 E. 42nd Street, New York 17, N. Y. Specify form ADC 708C.

• **CABLES:** A manual on National Electrical Code Type AVA cables covers application and design data for 3-conductor armored cables and single-conductor cable in conduit. Available from Rockbestos Products Corp, New Haven 4, Conn.

(*More Catalogs on page* 132)

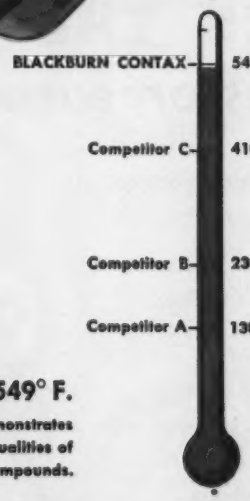
BLACKBURN

contax

IN NEW CRACK-PROOF CONTAINER

No messy, leaky tubes . . . no wasted paste

Blackburn Contax's new, no-leak plastic container will save time and tempers on the job . . . besides saving money in wasted material due to "throw-away" losses from cracked tubes. Contax is a mineral base grease with non-gassing zinc dust held in suspension. Zinc particles penetrate the oxide film, improving connection electrically—compound seals out air and moisture and protects against galvanic corrosion.



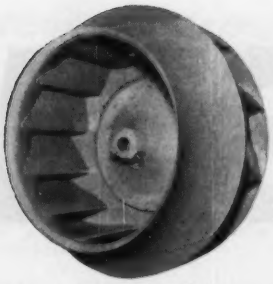
NO DRIPPING UP TO 549° F.

The thermometer chart at right demonstrates the superior heat resisting qualities of *CONTAX* over competitive compounds.

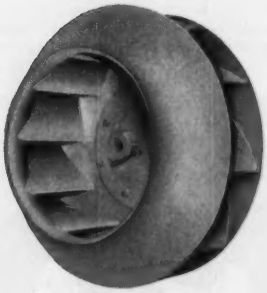
Available at electrical wholesalers everywhere

JASPER BLACKBURN CORPORATION

35 MADISON STREET • ST. LOUIS • MAIN 1-2821



TYPE "BA" WHEEL



TYPE "CA" WHEEL

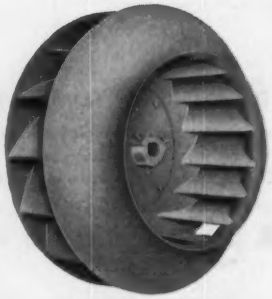
TYPE "AA" WHEEL

NOW—PICK THE FORCED

4 SERIES OF "BUFFALO" AIRFOIL

1. "BA", the basic wheel of the line — for many general forced draft and industrial requirements. Note broad air channels provided by extra-wide blades.
2. "CA", a wheel for higher pressures and lower capacities.
3. "AA", for lower pressures and higher capacities.
4. SEMI-AIRFOIL WHEELS like the "CLM", with airfoil noses and single thickness backward curved blades, closely approach performance of full airfoil wheels. This wheel has a definite application where a single thickness is advantageous.

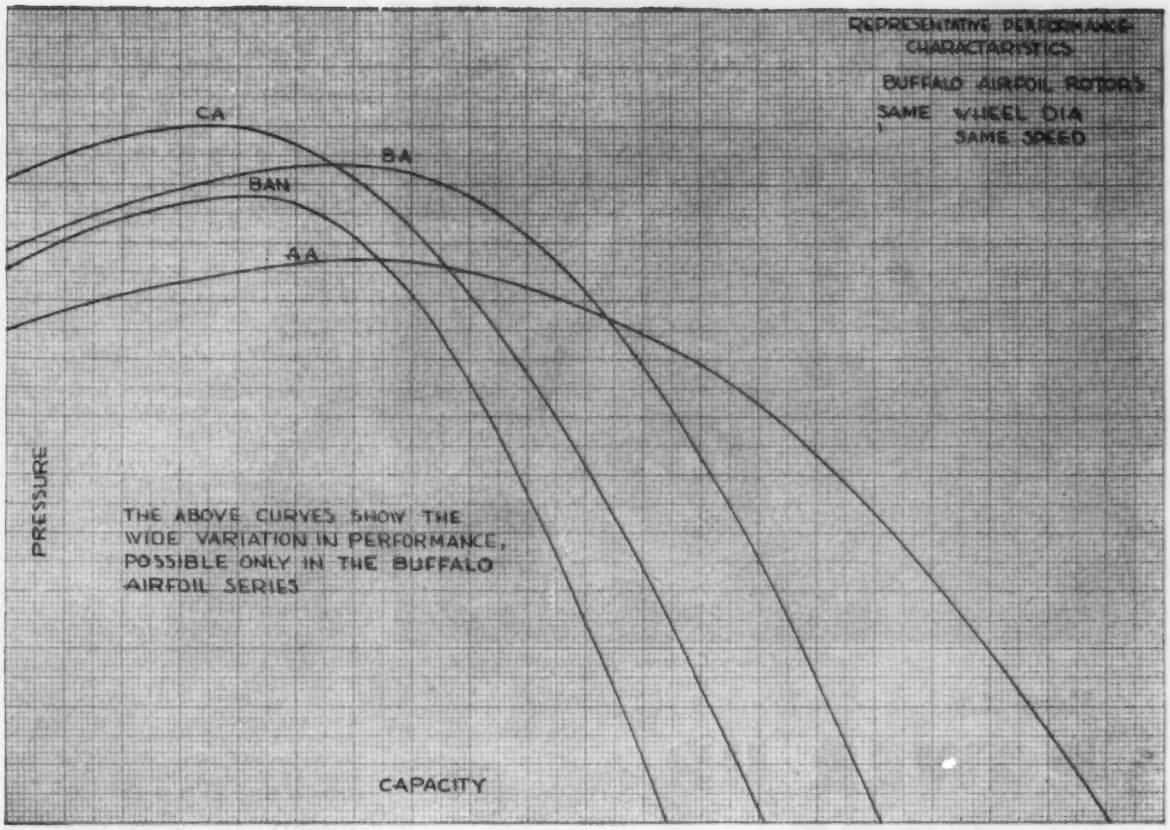
ALL WHEELS VARIABLE AS TO WIDTH, TO GIVE YOU PEAK EFFICIENCY FOR *YOUR* OPERATING CONDITIONS



TYPE "CLM" WHEEL

CATALOGS—BULLETINS

(Continued from page 128)



ONLY "BUFFALO" BRINGS YOU THIS BROAD SELECTION—PLUS EFFICIENCIES UP TO 92%

DRAFT PERFORMANCE YOU WANT

FANS TO MATCH YOUR CONDITIONS EXACTLY

Not just an airfoil fan, but *four complete series* — six types of interchangeable airfoil and semi-airfoil wheels in varying widths — to give you maximum efficiency for your operating conditions! "Buffalo" deep-blade airfoil design offers a new high in forced draft efficiency — not just on paper, but in actual operation. In addition to the effective, high-strength airfoil and semi-airfoil blades, these "Buffalo" Fans go beyond the usual concept of streamlining. From the smoothly rounded inlet to the divergent outlet, all sources of turbulence has been eliminated. If you wish the highest possible efficiency in a forced draft fan tailor-made for your particular operation, by all means, write for Bulletin FD106 and our engineering recommendations.

BUFFALO FORGE COMPANY
BUFFALO, N. Y.
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo"

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

Scott Paper Company—Everett, Washington

How to POWER UP with COPE

Paper mills are noted for their large use of power. Power engineers in the pulp and paper business know how to conserve materials and still guarantee long, trouble-free service. They can't afford a power breakdown.

More and more consulting engineers are specifying Cope Cable Trough to support power and control cables. Specify Cope on your next job.

Tommy Cope says: **"Keep your voltage high with Cope. You'll keep your costs low."**

D-617

Our engineers are ready to work with you. Write us today for full details on Cope Cable Supporting Systems.

T. J. COPE, INC.

COLLEGEVILLE 4, PENNSYLVANIA

CATALOGS—BULLETINS

(Continued from page 128)

● **MISCELLANEOUS:** Allis-Chalmers Mfg Co, 932 S. 70th Street, Milwaukee, Wis., has released the following publications:

Automatic excitation systems for turbogenerators are discussed in leaflet No. 05R8530. Four basic types are covered.

Network analyzer facilities of A-C available to utilities to help them solve system problems is the subject of bulletin No. 18B8526.

Outdoor oil circuit breakers, in ratings from 14.4 kv to 69 kv, 500 Mva to 3,500 Mva, are described in bulletin No. 71B8475A.

Emergency transformer capacity—Ways to utilize hidden transformer capacity during a long shutdown of a large power transformer are described in an 8-page leaflet, No. 01R8529.

● **INSULATING MATERIALS:** A 32-page catalog on electrical insulations for repair and maintenance of motors, generators, and electrical or electronic equipment is available from Insulation Manufacturers, 565 W. Washington Blvd, Chicago 6, Ill.

● **CENTRIFUGAL PUMPS:** The complete line of Ampco centrifugal pumps is described in Bulletin P-3b and insert P-3c issued by Ampco Metal, Inc., 1745 S. 38th Street, Milwaukee 46, Wis.

● **MEASURING & CONTROL EQUIPMENT:** A general catalog of its measuring and control equipment has been prepared by and is available from Simplex Valve & Meter Co, Lancaster, Pa.

● **COMPANY STORY:** "The Story of Fullerton" is the name of a folder giving the history of Fullerton Mfg Corp, Norwalk, Conn, manufacturers of commercial lighting fixtures.

● **PYROMETER:** Bulletin 9B describes the Model 9B Pyrotest, a portable potentiometer pyrometer manufactured by Technique Associates, 211 East South Street, Indianapolis 25, Ind.

● **NICKEL-CADMIUM BATTERIES:** The details of development, construction, operation, and curves of discharge and charge characteristics of NICAD's high-output sintered plate nickel-cadmium batteries are described in an 8-page technical report published by Nickel Cadmium Battery Corp, Easthampton, Mass.

● **ALNICO MAGNETS:** "The Newest of the Alnicos, ALNICO 5cb" is the name of a brochure that gives the physical properties, dimensional limitations, and a typical demagnetization and energy product curve of Alnico 5cb, published by Thomas & Skinner, Inc, 1120 E. 23rd Street, Indianapolis, Ind.

● **DISTRIBUTION TRANSFORMERS:** A new catalog that gives the electrical and mechanical data and the price list of its Pole Star distribution transformers has been issued by Pennsylvania Transformer Co, Canonsburg, Pa.

● **TEFLON:** A 4-page bulletin on "Teflon", DuPont's trade name for tetrafluoroethylene resin, as it applies to their equipment now in production has been issued by Haveg Industries, Inc, 900 Greenbank Road, Wilmington 8, Del.

(More Catalogs on page 136)

Now! Reliable

ALL-ALUMINUM

SQUEEZ® SLEEVES

in all service entrance combinations

ALUMINUM - ACSR - COPPER from SIZES No. 10 to No. 2

These heavy-wall, all-aluminum *SQUEEZ* Sleeves are cleaned, greased and capped, ready for use. The colored plastic caps that code the sizes need not be removed, they are punctured by conductors. The solid center barrier locates and separates conductors and assures an even distribution of the factory added grease to all strands within the sleeves.

Fifteen sleeves, color coded and marked provide for all conductors No. 10 to No. 2.

RELIABLE NO. 10-XPJ *SQUEEZ* TOOL

For maximum versatility with minimum truck and working space, the Reliable No. 10-XPJ combines three standard die grooves in a toggle type tool.

Handles are coated with bright orange vinyl plastisol that provides insulation when used for work on secondaries. Also available with painted handles. Bright color helps avoid loss.

FREE SAMPLES Just ask for your free samples of Reliable Aluminum *SQUEEZ* Sleeves . . . they'll be sent promptly.

Reliable ELECTRIC COMPANY CHICAGO 12, ILLINOIS

POWER LINE CONNECTORS AND CONSTRUCTION SPECIALTIES

NEW, EXPANDED, STREAMLINED, AUTOMATIC DISTRIBUTION TRANSFORMER FACILITIES:

MOLONEY ELECTRIC COMPANY

Catalogs—Bulletins

NOW IN PRODUCTION

YES, now we are operating full scale at double our former production capacity to produce HyperCore Distribution Transformers in the quantities the utilities demand.

Here under this roof are the finest fabricating, assembling and automatic testing facilities in the industry. The capacity of these facilities insures that our warehouse stocks throughout the country can be maintained to insure delivery... in the quantities and ratings you desire... when you want it. Also . . . you get 100% pre-tested, pre-proved HyperCore Distribution Transformers that are now automatically tested.

Call your Moloney representative today. Check on immediate delivery from stock. Only Moloney HyperCore Transformers can offer you operating efficiency . . . 100% pre-tested and pre-proved.

ME57-3

MOLONEY ELECTRIC

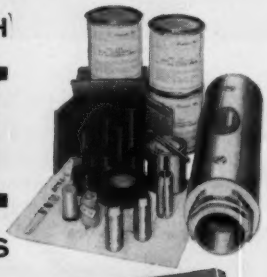
Power Transformers • Distribution Transformers • Load Tap Changing Transformers • Regulating Transformers • Step Voltage Regulators • Primary Unit Substations • Secondary Unit Substation Transformers • Network Transformers • Series Street Lighting Transformers • Subway Transformers • Industrial Dry Type Transformers • Transformers and Inductors For Electronics

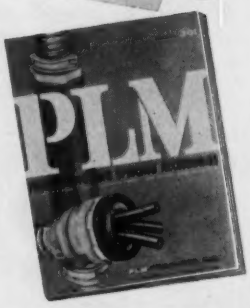
FACTORIES AT ST. LOUIS 20, MO. AND TORONTO, ONT., CANADA
SALES OFFICES IN ALL PRINCIPAL CITIES

Anderson Electric's exclusive Vers-a-groove T-Connectors feature 3-piece

SUPERIOR
SWITCHBOARD & DEVICES CO.
CANTON, OHIO
A subsidiary of
The Union Metal Manufacturing Company

quick answers
to cable splicing problems
WITH
PLM
SPLICING BOXES AND KITS





• No need for detailed designing, specifying and ordering of materials for cable joints! PLM provides quick answers in PLM Unit Package Splicing Kits, complete with casings for 2, 3 or 4-way joints, all materials needed, and detailed installation instructions. You specify cable sizes and ratings, or order from new, 52-page PLM Catalog 301.

Casings supplied in cast aluminum or bronze, in ratings through 23 kv, for joints in or to armored cable. Other unit package splicing kits for non-metallic sheathed and lead-covered cable. Write for Catalog 301 or ask for prices on your needs.

PLM PRODUCTS, INC. · 3873 West 150th Street · Cleveland 11, Ohio
WIRE AND CABLE FITTINGS AND ACCESSORIES

Catalogs—Bulletins

(*Continued from page* 132)

• **LIGHTING EQUIPMENT:** Their 1957 Condensed Catalog featuring new information on Wakefield's luminous ceilings, modular lighting equipment, pendant mounting fixtures and high frequency lighting system is available from Wakefield Co, Vermilion, Ohio.

• **AUTOMATIC CONTROLS:** A 12-page catalog describes M-H's automatic temperature, pressure, and humidity controls; flameguard system; industrial motor controls; relays; dampers, operators; and panels and cubicles manufactured by Minneapolis-Honeywell Regulator Co, Industrial Division, Philadelphia 44, Pa.

• **UNIT HEATER HANDBOOK:** A new vest-pocket edition of the "Venturafin Unit Heater Handbook" is now available from American Blower Corp, Detroit 32, Mich.

• **VARNISHED-CAMBRIC CABLES:** A recently issued catalog covers the complete line of varnished-cambric cables in voltage range from 600 to 5,000 v for single and 3-conductor cables braided or lead-sheathed manufactured by Rockbestos Products Corp, New Haven 4, Conn.

• **LIGHTING ENGINEERING:** An illustrated folder covers the lighting engineering job done in the offices of Connecticut Light & Power Co by Fullerton Mfg Corp, Norwalk, Conn.

• **HARD RUBBER MOLDINGS:** "Big Moldings in Hard Rubber are no problem . . . ," is a 4-page brochure containing information on typical, extra large hard rubber products that can be fabricated by Stokes Molded Products, Taylor & Webster Streets, Trenton 4, N. J.

• **WIRE & CABLE:** A wire and cable catalog which discusses the composition, tested "in use" properties, and suggested applications of Type RR Rubber Insulated-Neoprene Sheathed Non-Metallic Cables may be had from National Electric Products Corp, Gateway Center, Pittsburgh 22, Pa.

• **ELECTRICAL EQUIPMENT:** A pictorial index of products manufactured by them has been published by Nelson Electric Mfg. Co, P.O. Box 5385, Tulsa 16, Okla.

• **THERMAL IMAGING DEVICE:** A brochure, designated Bulletin RD515, describes the thermal imaging device known as the "Evaporograph". The instrument may be used to test bonds and laminations, for insulation studies, temperature studies of combustion equipment, etc. Available from Baird Associates—Atomic Instrument Co, 33 University Road, Cambridge 38, Mass.

• **TERMINATING & SPLICING ACCESSORIES:** Catalog 301 covers the line of PLM terminating and splicing accessories manufactured by PLM Products, Inc, 3871 W. 150th Street, Cleveland 11, Ohio.

• **LIGHTING FIXTURES:** The complete line of fluorescent lighting fixtures is covered in 400-page catalog No. 55 issued by Ruby-Phillte Corp, 32-02 Queens Blvd, Long Island City, N. Y.

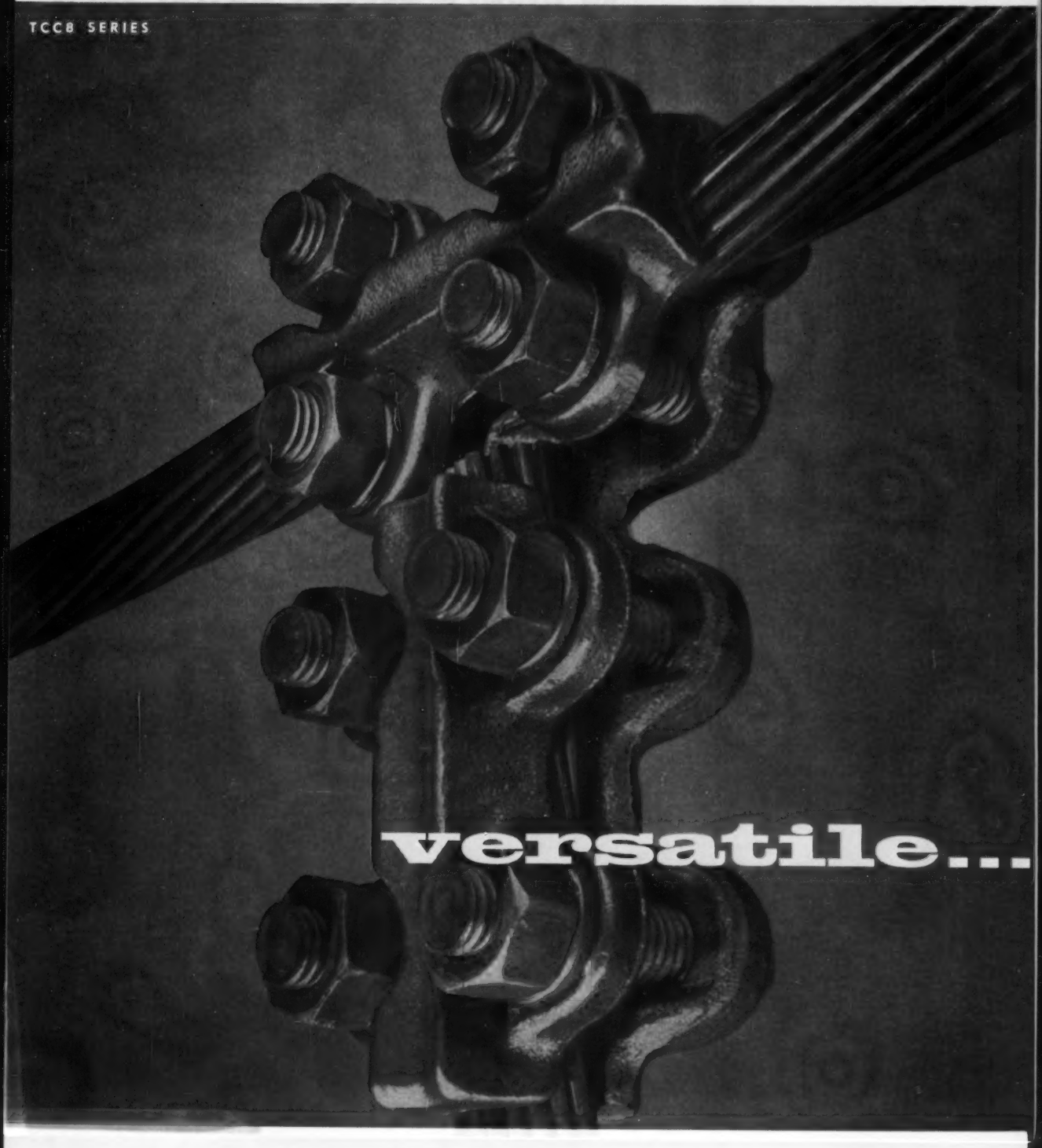
(*More Catalogs on page* 140)

ANDERSON ELECTRIC

Anderson Electric's exclusive Vers-a-groove T-Connectors feature 3-piece design for easy installation . . . 8-bolt construction for controlled clamping pressures and greater contact length . . . reversible clamp for increased cable range and wider application.

ANDERSON ELECTRIC CORPORATION
Birmingham 1, Alabama

Aluminum & Bronze Power Connectors • Clamps • Fittings • Accessories for SUBSTATIONS • TRANSMISSION • DISTRIBUTION



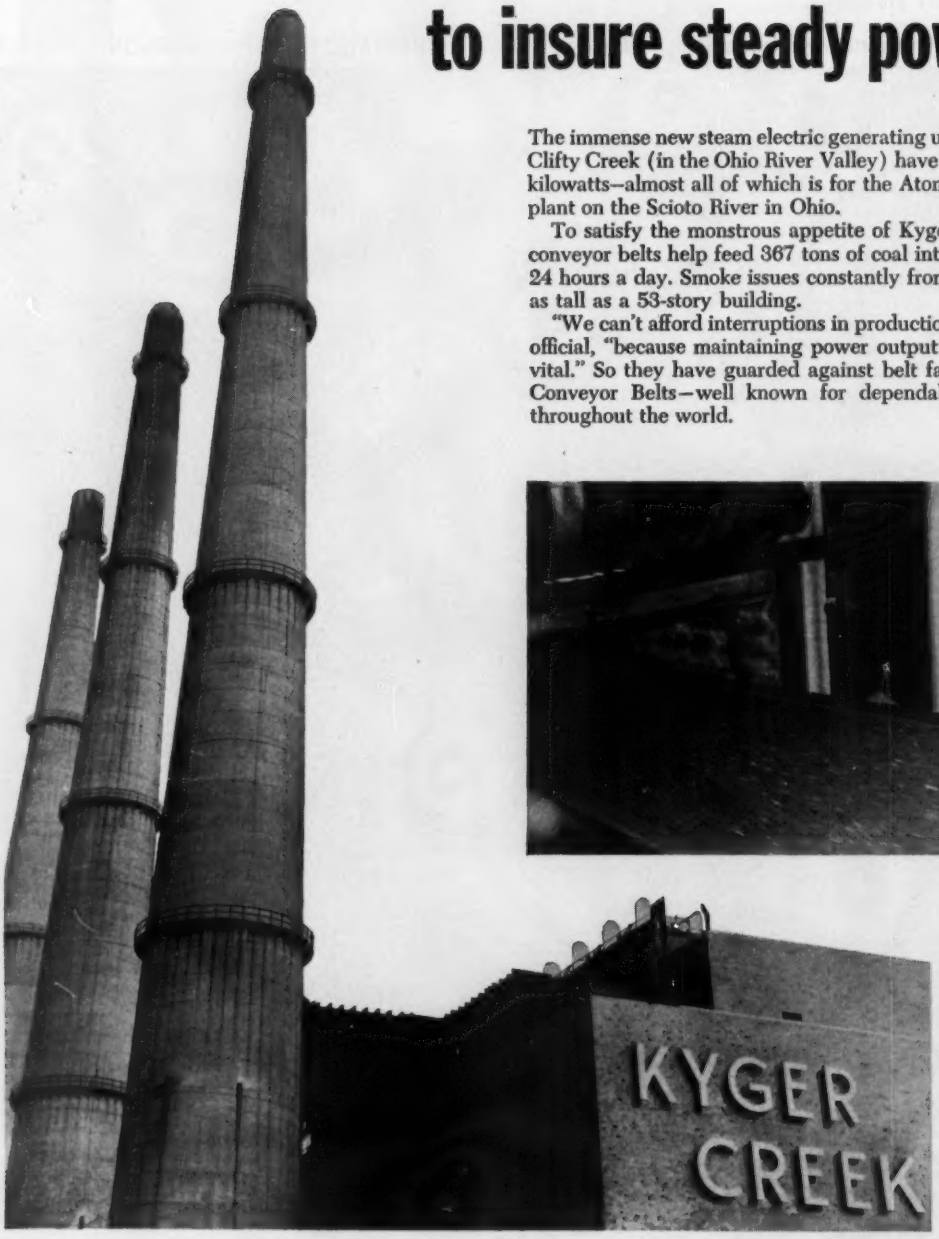
US RUBBER CONVEYOR BELTING

Delivering 367 Tons of Coal per Hour... to insure steady power flow

The immense new steam electric generating units at Kyger Creek and Clifty Creek (in the Ohio River Valley) have a capacity of 2,365,000 kilowatts—almost all of which is for the Atomic Energy Commission plant on the Scioto River in Ohio.

To satisfy the monstrous appetite of Kyger Creek, U. S. Rubber conveyor belts help feed 367 tons of coal into its boilers every hour, 24 hours a day. Smoke issues constantly from the giant stacks, each as tall as a 53-story building.

"We can't afford interruptions in production," says a ranking plant official, "because maintaining power output for the atomic plant is vital." So they have guarded against belt failure by selecting U. S. Conveyor Belts—well known for dependability by power plants throughout the world.



(above)
The Number One conveyor belt emerging from the unloader hopper at Kyger Creek. This 48" wide U. S. Matchless® belt provides excellent troughability, extreme rip resistance, fine training and long life. This excellent conveyor system and belting mean considerable savings in manpower to move the coal supply.

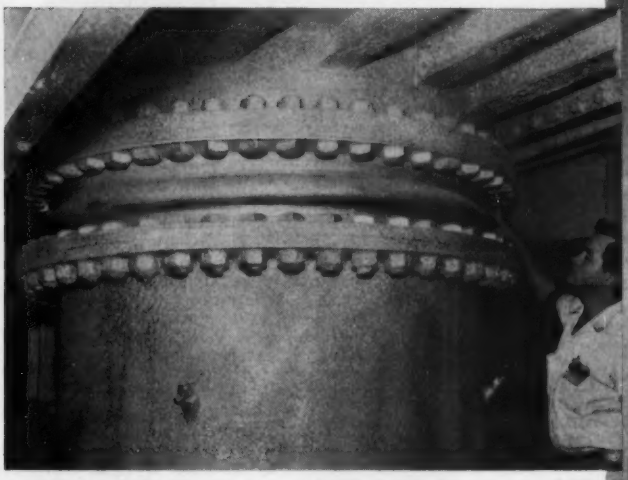
84,000 Gallons of Water per Minute for atomic energy plants

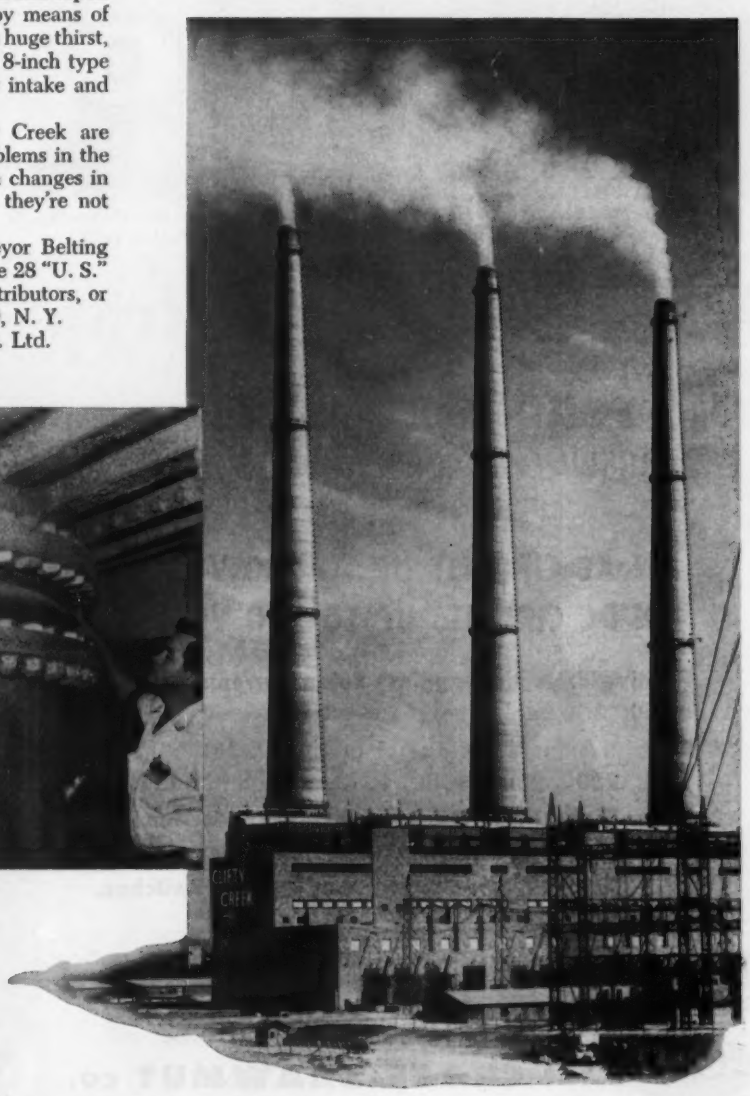
The Clifty Creek steam electric plant brings in and expels river water at 84,000 gallons per minute, by means of circulating water pumps. To help quench this huge thirst, U. S. Rubber Expansion Joints (from small 8-inch type to big 66-inch type) are used on the water intake and discharge pipes.

These U. S. Expansion Joints at Clifty Creek are handling the contraction and expansion problems in the pipe lines excellently. They can take sudden changes in temperature, they can handle shocks, and they're not bothered by corrosion.

A complete line of U. S. Rubber Conveyor Belting and Expansion Joints is available at any of the 28 "U. S." District Sales Offices, at selected "U. S." distributors, or write us at Rockefeller Center, New York 20, N. Y.

In Canada, contact Dominion Rubber Co. Ltd.

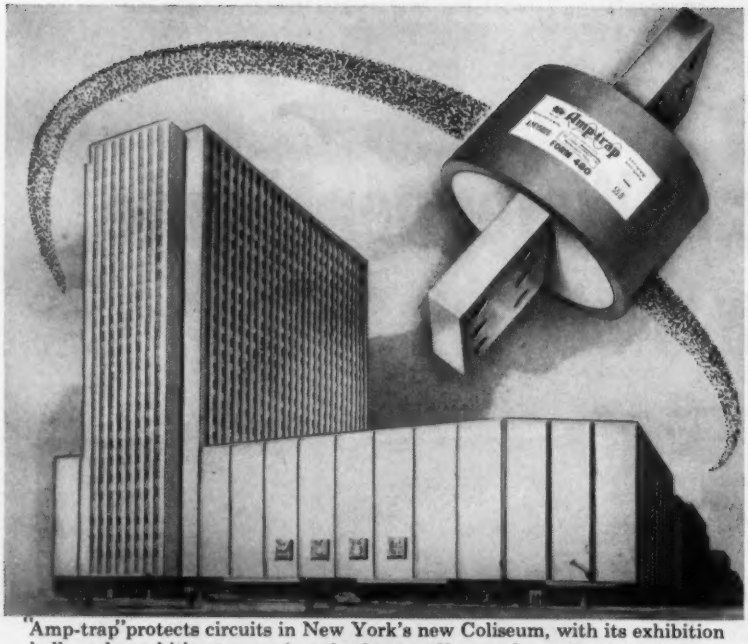




Above is one of the many 66-inch U. S. Expansion Joints on a water intake line at the Clifty Creek Plant. None of these joints, no matter what the size, has ever given Clifty Creek any problem. They are performing excellently, on a tough job.

Mechanical Goods Division

United States Rubber



"Amp-trap" protects circuits in New York's new Coliseum, with its exhibition halls and amphitheatre, against the danger of heavy short- circuit or fault currents, regardless of varying load requirements.

SHAWMUT'S FORM 480 Amp-trap®

FOR APPLICATION ON ENTRANCE SWITCHES, BUSWAYS, FEEDER SERVICES AND CIRCUIT BREAKERS
ON AC CIRCUITS UP TO 600 VOLTS
ON DC CIRCUITS UP TO 250 VOLTS

- Positive Protection against Super currents as high as 500,000 peak amperes available.
- Built in Ampere Ratings of 600, 800, 1000, 1200, 1600, 2000, 2500, 3000, 4000, 5000 and 6000.
- Sharp Current Limitation Characteristics for Backup Protection of Air Circuit Breakers, Switches, etc.
- Easily Adaptable into Busses, Bus Ducts or Switches.
- Economical in First Cost and Replacement.
- Very Low Watt Loss — Cool Operation.

Copyright 1957, The Chase-Shawmut Co.

480 Amp-trap® — "Awake At The Switch"

OVER 60 YEARS — FROM ERGON TO ELECTRONICS

THE CHASE-SHAWMUT CO.
373 MERRIMAC STREET • NEWBURYPORT, MASSACHUSETTS
Subsidiary of I-T-E CIRCUIT BREAKER CO., Philadelphia, Pennsylvania

Catalogs—Bulletins

(*Continued from page* 136)

• **RESEARCH FACILITIES:** Electrical Engineering Research facilities at Armour Research Foundation of Illinois Institute of Technology, Chicago, are the subject of five 4-page folders published by the Foundation. Write R. B. Schulz, Electrical Engineering Research Dept, Armour Research Institute, 10 W. 35th Street, Chicago 16, Ill.

• **MERCHANDISE PACKAGING:** "How to Merchandise with Corrugated Boxes" is the name of a 32-page booklet covering what its name implies. Published by Hinde & Dauch, Sandusky, Ohio.

• **MACHINE TOOLS:** The entire line of the manufacturer's precision machine tools is illustrated and priced in an 80-page catalog (No. 5700) issued by South Bend Lathe Works, South Bend 22, Ind.

• **MOTOR CONTROLLERS:** Their line of motor controllers is covered in the Seventh Edition Handy Catalog published by Allen-Bradley Co, Milwaukee 4, Wis.

• **SYNTHETIC PARAFFIN:** A 4-page brochure telling the story of a synthetic pariffin imported from South Africa called PARFLINT has been made available by Moore & Munger, 33 Rector Street, New York 6, N. Y.

• **COMPUTERS:** A booklet entitled "High-Speed Analog Computers, Key to Rapid System Development", answers questions for those concerned with automation and control systems. Write GPS Instrument Co, Inc, 811 Boylston Street, Boston 16, Mass.

• **CONTACTS:** A 4-page "short form" catalog describes materials, properties, forms and uses of the line of electrical contacts made by Gibson Electric Co, 8351 Frankstown Ave, Pittsburgh 21, Pa.

• **AUTOMATIC CONTROLS:** Their latest catalog of automatic controls, listing more than 100 items, has been released by Mercoid Corp, 4201 Belmont Ave, Chicago 41, Ill.

• **TAPE CONTROL SYSTEM:** The principles and mode of operation of the DIGI-MATIC tape control system for machine tools are described in a 12-page booklet published by Electronic Control Systems, Inc, 2136 Westwood Blvd, Los Angeles 25, Calif.

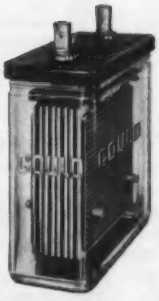
• **SPEED REDUCERS:** A 4-page folder describes the worm gear speed reducers manufactured by Cleveland Worm & Gear Co, 3293 E. 80th Street, Cleveland 4, Ohio.

• **GLASS:** Manufacturing methods, applications and the history of glass are explained in a brochure entitled, "This is Glass", published by Corning Glass Works, Corning, N. Y.

• **TEMPERATURE CONTROL:** A descriptive bulletin, No. 106, covers the Model L-1S temperature control made by Burling Instrument Co of Chatham, N. J.

• **SUBSTATION TRANSFORMERS:** Bulletin 9004-B covers I-T-E unit substation transformers, liquid filled and dry types, rated 112.5 through 3,000 kva, made by I-T-E Circuit Breaker Co, Philadelphia 30, Pa.

You Get "Hidden Horsepower" from gould BATTERIES



America's Finest!
GOULD PLANTÉ
The Aristocrat of
Stationary Batteries

Behind every Gould Battery is the industry's largest field engineering staff

Gould engineers train your personnel . . . set up preventive maintenance programs . . . establish efficient battery charging methods . . . and otherwise help you make use of the "Hidden Horsepower" in every Gould Battery.

Specify Gould and see.
Gould-National Batteries, Inc., Trenton 7, N. J.

©1957 Gould-National Batteries, Inc.

Always Use Gould-National Automobile & Truck Batteries *More Power to you from Gould*

THE STATES COMPANY

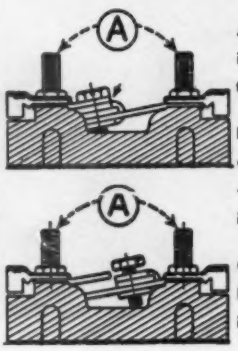
CHECKING A CIRCUIT WITHOUT DISTURBING PERMANENT WIRING IS EASY . . .

. . . IF YOU USE

STATES

NT TERMINAL BLOCKS

States exclusive sliding link feature permits checking circuit at any time without disturbing permanent wiring. It's as easy as A, B, C.

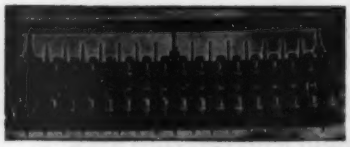


A. Just attach instrument to terminal posts.

B. Slide link out of contact — take reading.

C. Slide link back and bolt in position.

All testing done without touching permanent wiring. Built in any number of poles desired, front or back connected, with or without coding strip, with or without cover.



From 1 to 60 Poles

THE STATES COMPANY
19 New Park Ave., Hartford, Conn.

Please send me further information on NT Terminal Blocks—Cat. 1, Sec. 6

Name.....Title.....

Firm Name.....

City.....Zone.....State.....

BOOKS

Received Since January 7

Engineering Structural Failures. By Rolt Hammond. Published by Philosophical Library, Inc., 15 East 40th St, New York 16, N. Y. 224 pages, illustrated. Price $12.00.

Introductory Electrical Engineering. By George F. Corcoran and Henry R. Reed. Published by John Wiley & Sons, Inc., 440-4th Ave, New York 16, N. Y. 527 pages, illustrated. Price $7.95.

Electric Heating for Industry

Industrial Furnaces—Vol. II. By W. Trinks. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 358 pages, illustrated. Price $10.00.

In its third edition, Volume II of this survey of industrial furnace practice covers a large number of techniques and materials developed since the last edition appeared in 1942. Apparently intended as a quick reference book rather than a detailed treatise, it uses only simple arithmetic. Theory is held to a minimum and practical aspects are emphasized.

Sections on induction heating, electric salt baths and a variety of resistance materials (molybdenum, Kenthal, silicon carbide, and glass) will be valuable both to utility power sales engineers and to industrial electrical engineers. Sales personnel will find critical cost and engineering comparisons of fuels, furnace types and material handling methods of particular interest.

Designing Relay Protection

The Art and Science of Protective Relaying. By C. Russell Mason. Published by John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y. 410 pages, illustrated. Price, $12.00.

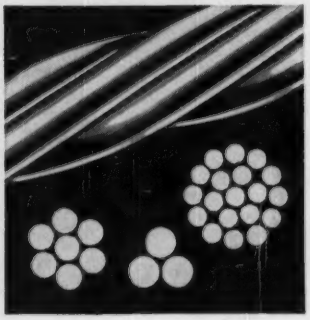
This textbook deals with relay protection of all elements of a power system. It begins with the philosophy of protection and then discusses the operating principles of various relays and their relation to other power-system elements.

Well illustrated, the book deals at length with the design and application of protective relaying for generators, transformers, buses, and transmission and distribution lines.

This elementary book assumes no prior knowledge of the subject and gives a complete list of references to basic source material. For these reasons it would be particularly valuable to the beginner or the relay instructor. However, because of its wealth of information, particularly on design and application, it would be a useful reference book for the practicing relay engineer.

PAGE

Galvanized Strand



for Guy, Messenger, Catenary and many other applications

• Do you use strand for guy, catenary, messenger, transmission line or overhead ground applications? There is a PAGE Galvanized Strand to meet every requirement (also PAGE Stainless Steel Strand for corrosive or other special service conditions).

All Standard Grades

• PAGE Galvanized Strand is made in five grades—Common, Siemans-Martin, High Strength, Utility and Extra High Strength. All grades can be furnished in both regular and PAGE Preformed Strand. All are available in 3-, 7- and 19-wire construction—and all grades meet all commercial and Government specifications. You get dependable performance and excellent value in every foot of PAGE Strand.

Another fine PAGE product

• PAGE Stainless Steel Lashing Wire is ideal for lashing conductor cables to a strand messenger by machine. Available in 3 grades—each in 2 sizes.

Send for Folder DH-480 . . . it contains much useful information about strand and its uses. Write us at Monessen, Pa.

Monessen, Pa., Atlanta, Chicago, Denver, Detroit, Houston, Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Bridgeport, Conn.

AMERICAN CHAIN & CABLE
PAGE STEEL AND WIRE DIVISION

Engineers from Blaw-Knox and Arthur D. Little, Inc., make intermediate check on data as operator (on left) watches signals on control console of electronic computor

Power Piping Division develops

new "6 x 6" Flexibility Matrix Method —cuts calculation time from months to a day

Present day operating requirements demand power piping systems that can handle extremely high temperatures and pressures—often up to 4500 psi and 1100° F. Under these critical conditions pipe may expand as much as ten inches in a hundred feet of pipe.

To be sure of adequate flexibility of the piping system, the terrific stresses set up by this expansion must be accurately computed before fabrication. And these computations are often so complex that skilled stress analysts have had to take two to three months, sometimes more, to complete them.

Now, by using the Blaw-Knox "6 x 6" Flexibility Matrix Method, computation time is cut to one day.

Developed in an 18-month joint research project of the Blaw-Knox Power Piping Division and the Arthur D. Little, Incorporated, Cambridge, Mass., research consultants, this new method of computation takes advantage of the high speed and accuracy of electronic computers.

Results are: Completely automatic computation with no limitations on the complexity of the systems. Full accuracy—as any inconsistencies in the input data are detected by the machine and all results are carried to six significant figures. Tremendous saving in time. Highly profitable saving in costs.

Originally developed for calculating stress analysis on systems fabricated or designed by Blaw-Knox Power Piping Division, this new method of computation is now available to consulting engineers, companies and individuals responsible for the design of power piping systems.

Bring your piping stress problems to our Power Piping Division for a discussion with our experienced piping engineers.

BLAW-KNOX

BLAW-KNOX COMPANY
Power Piping and Sprinkler Division
Pittsburgh 33, Pennsylvania

Complete facilities for prefabrication and erection of piping systems—complete line of functional spring hangers, assemblies and vibration eliminators—complete engineering and installation of Automatic Sprinkler Systems

Cleveland Electric generates more power, more efficiently

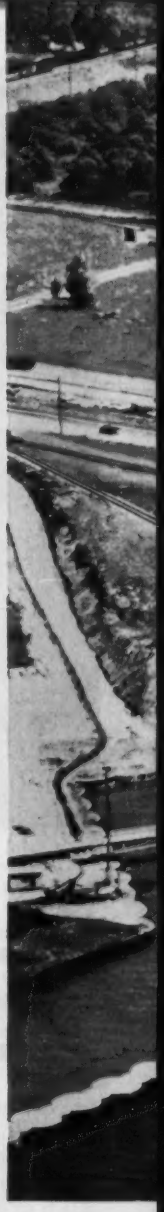
Worthington heat and fluid transfer equipment helps Eastlake Station attain efficiency of ¾ lb of coal/kwhr

To a large extent good heat rate in any power plant is determined in three important places . . . in the boiler room where steam is produced, in the turbine room where electricity is generated, and in the heat and fluid transfer section of the plant where the condenser, its auxiliaries, and the boiler feed pumps play an important part in controlling plant heat balance. It's a fact that efficiency depends as much on all this latter equipment as on the rest of the plant.

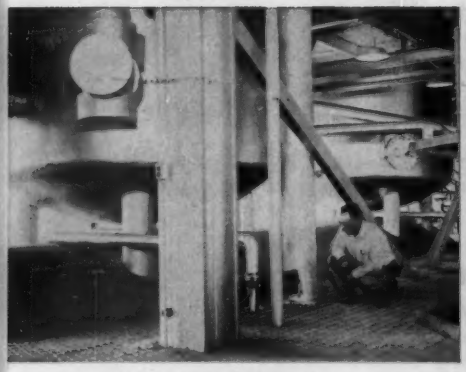
That's why in designing their new 660,000 kw Eastlake plant, Cleveland Electric Illuminating engineers spent hundreds of hours studying various system arrangements. For all four generating units the condensers, deaerators, boiler feed pumps, vacuum pumps, and other miscellaneous auxiliaries were supplied by Worthington who offered coordinated design, engineering and manufacturing on these products. This careful study contributed greatly to the achievement of one of the most efficient and modern steam power plants in operation today.

This "system wise" experience has been responsible for many Worthington steam power equipment advances such as high speed boiler feed pumps running up to 9,000 rpm; full contact deaerators which need practically no maintenance because they do away with the vent condenser; and "Double Folded Tube Layer" condensers which can be "tailored" to available space.

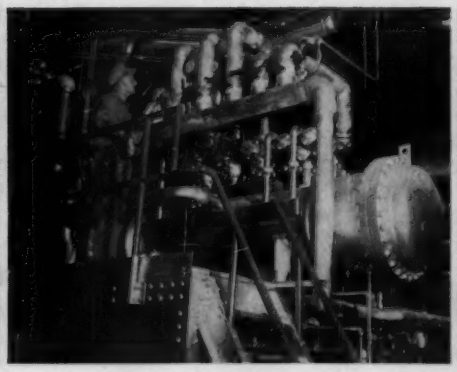
We'd like to put this experience to work for you. Just get in touch with us at your nearest Worthington District Office. Or write to Worthington Corporation, Steam Power Dept., Harrison, New Jersey. In Canada: Worthington (Canada) 1955, Ltd., Toronto, Ontario. S64



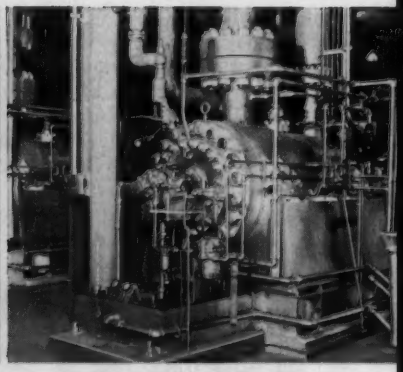
WORTHINGTON



Deaerators. This 1,515,000 lb./hr. unit at Eastlake consists of two vertical shells mounted on horizontal storage tank.

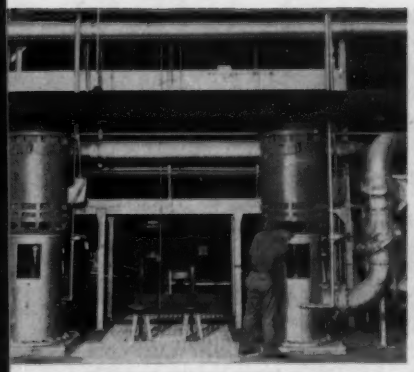


Ejectors and Vacuum Pumps. One of four steam-jet air ejectors serving condensers at Eastlake.

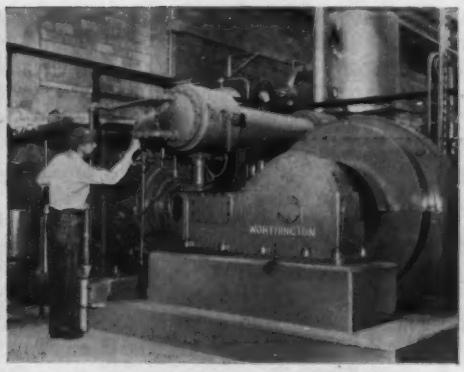


Boiler Feed Pumps. Operating at 3,050 psi, three 9-stage pumps supply the largest generating unit at Eastlake.

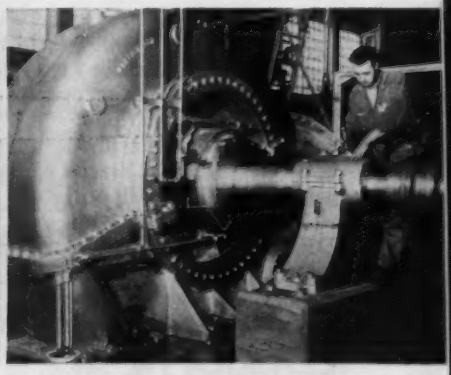
One of the world's most modern, the Eastlake Station of The Cleveland Electric Illuminating Company has a generating capacity of 660,000 kw.



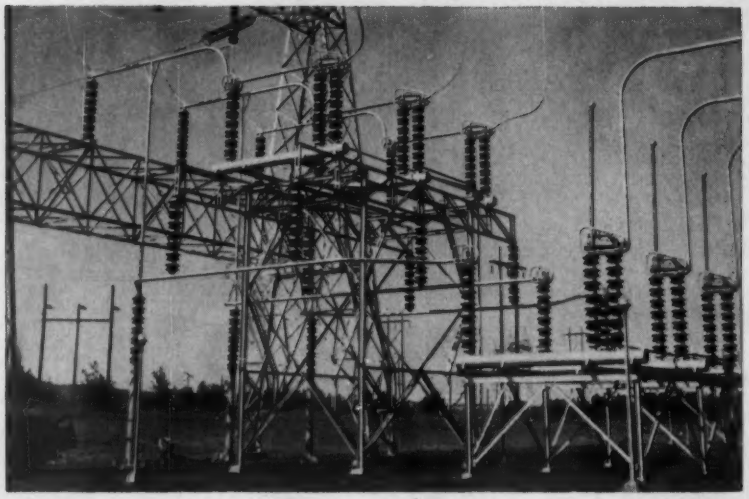
Condensate Pumps. Behind these pumps is the 110,000 sq. ft. condenser serving largest Eastlake generating unit.



Compressors. One of three Worthington horizontal duplex units which supply all of the air for Eastlake's operation.



Circulating Pumps. This main condenser circulating pump, at Eastlake, is of Worthington volute "Mixflo" type.



BPA Puts 345-Kv Air Switches in Service

This arrangement of 345-kv air switches is now in service at the Umatilla, Oregon, end of Bonneville Power Administration's 175-mile McNary-Ross line. A similar switching arrangement is at the other end of the line. These installations form part of the system supplying power to the city of Portland.

Having a rating of 1,600 amp continuous current, 70,000 amp momentary, and 1,300-kv BIL, the switches are Federal Pacific Electric Co's type TG-4. They are reportedly among the first in the U. S. to be operated at the extra high transmission voltage. Operation is provided by geared motor remotely controlled.

Turbo Furnace Sales Up Reports Riley Stoker

Turbo furnace sales have increased to 17 units since being marketed four years ago, reports Riley Stoker Corp, Worcester, Mass. Seventy percent of the sales were to utilities.

All units represent a total steam capacity of 9,429,000 lb per hr. Largest turbo furnace is rated 1,550,000 lb per hr to operate at 2,125 psi, 1,000F/1,000F. It was sold to a Louisiana public utility. Smallest unit on the list has a steam capacity of 175,000 lb per hr.

Three units have been sold to Delaware Power & Light Co to generate a total of 1.5 million lb of superheated steam per hr and to burn fluid coke (EW, Jan. 7, pp 60-62) supplied by a nearby petroleum refinery.

Latest turbo furnace sold for industrial use was in December 1956 to Dow Chemical Co for installation at its Midland, Mich., plant. This unit will be the first sold to burn pulverized coal.

Inventors Hit New Highs With Westinghouse Ideas

Patent disclosures last year were 13% above 1955 and set a new company record, Westinghouse Electric Corp announced. Engineers and scientists of the company submitted three times the disclosures made in 1950.

There were two and one-half times as many active investors in 1956 as there were in 1950. For this group, 4,374 checks were awarded totaling some $200,000 in additional earnings. Forty out of 50 engineering locations met or exceeded goals.

Coleman J. Miller of the Baltimore, Md., electronics division won a $5,000 award for his invention of the Paraballoon antenna for radar. A $3,000 award was given W. R. Wickerham of the motor and control division, Buffalo, N. Y., for a crane control invention.

Water-Cooled Generators to be Built by Met.-Vickers

London—(McGraw-Hill WORLD NEWS). Metropolitan-Vickers Electrical Co received an order for two 200-Mw steam turbine-generators. Water-cooled windings are to be furnished in the generators (EW, Jan. 21, pp 89 and 92).

The order amounting to more than $84 million from the Central Electricity Authority includes associated equipment to be installed in Willington "B" power station. Commissioning dates are planned for 1961.

Vise Type Connector Set by Penn Union Electric

Connectors designed to operate like miniature vises are being produced by Penn-Union Electric Co, Erie, Pa. Known as the Vise Grip line, each unit consists of a body, slide and threaded member which hold the assembly. The body and slide are cast of aluminum bronze. A compression forming reaction force is created, a Penn-Union spokesman said.

This connector line features:

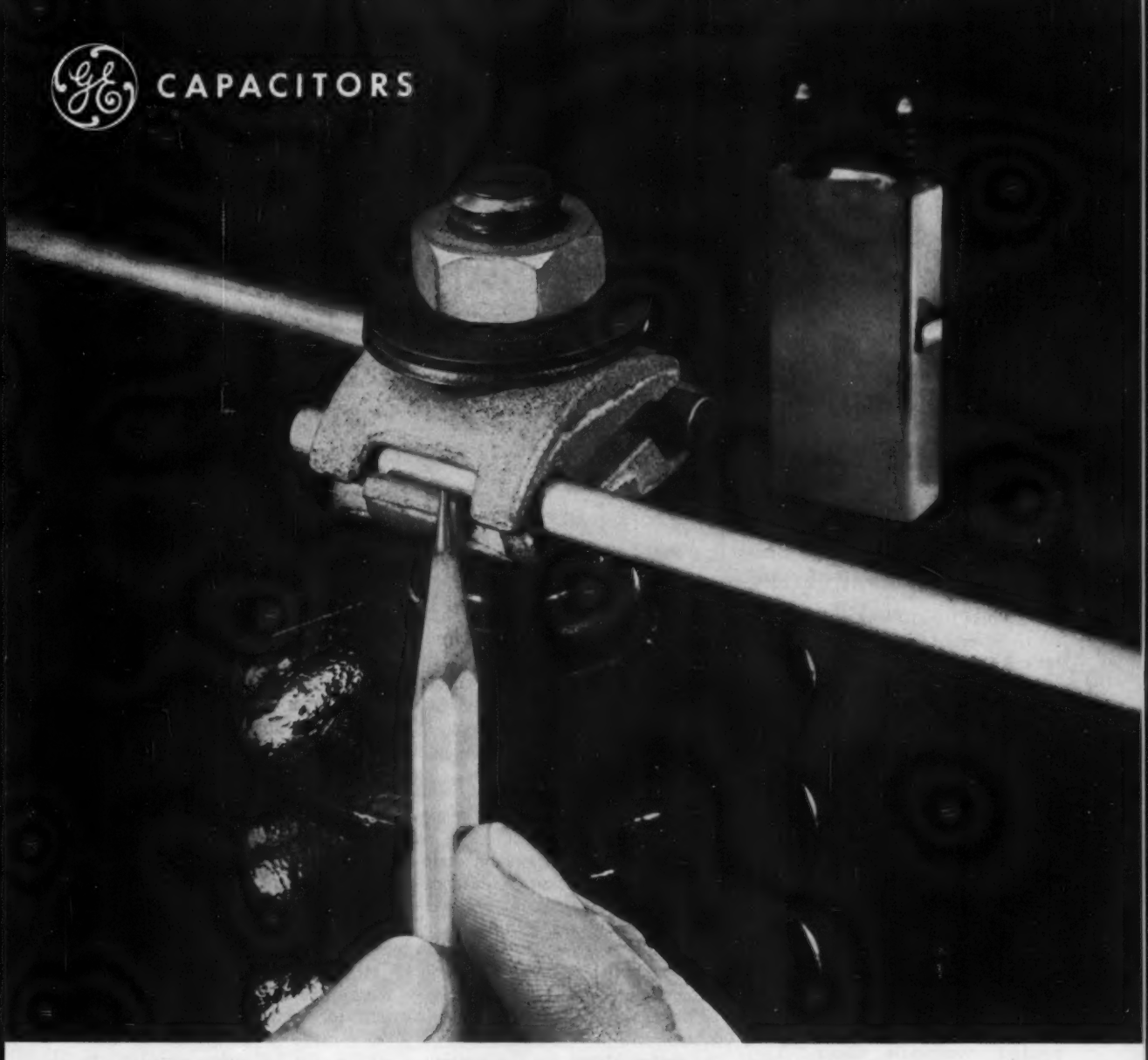
Direct assembly to two maximum conductors without slide rotating out of body, an advantage for "hot-line" work.

Use of only two sizes of hex heads.

U. S. Aluminum Production

Primary aluminum production in the United States for December, 1956, amounted to 148,580 tons, according to the Aluminum Association, New York. This is an increase of about 3,500 tons over the 145,081 tons produced in November. It was also an increase

(*Continued on page* 148)



Cold flow gets big squeeze

A capacitor terminal can't stop the cold flow of aluminum conductors, but it can adjust to it. The "big squeeze" provided by General Electric's terminal assembly does just that. Here's what happens.

No matter how the conductor shrinks, expands, or "flows," the jaws of the connector* bear down with a continuous quarter-ton grip. Cone-disk Belleville washers provide this firm, flexible, follow-up pressure that maintains full area contact and helps to keep out corrosion.

The result? No hot joints from corrosion or poor contact, even on switched capacitor banks with frequent thermal cycling. The big squeeze on cold flow is another Engineered Extra you get only with G-E capacitors.

Any questions? Your G-E Apparatus Sales Engineer can probably answer them. Or write to General Electric, Section 445–1, Schenectady 5, New York.

*General Electric's jumbo, parallel-groove connector, ideal for Al or Cu.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Aluminum Production

(*Continued from page* 146)

of about 7,900 tons over 140,682 tons in December 1955. Total aluminum production in 1956 was 1,679,430 tons, up about 113,710 tons from 1,565,719 tons in 1955. All-time record month was July 1956 when 151,624 tons were produced. Another all-time record was the 4th quarter of 1956 with a production of 442,780 tons.

Electrical Manufacturers to Exhibit at Columbus, O.

An Electrical Manufacturers Exposition is to be held Feb. 26, 27 and 28, at Columbus, Ohio. Co-sponsors are Electrical Manufacturers Association of Central Ohio and Columbus & Southern Ohio Electric Co.

Products of 127 manufacturers from 70 cities in 18 states are to be exhibited. Displays will consist of electrical apparatus used by many types of industrial operations as well as by manufacturers.

M & M BRIEFS

General Electric Co's Mexico affiliate, Manufacturera GE, S.A., will soon begin production of industrial equipment. Firm has made consumer products there for past nine years.

E. I. du Pont de Nemours & Co has started work on a plant which will produce hyper-pure silicon. The 10,500-acre site is in western North Carolina. Production of 50,000 lb of semi-conductor grade silicon a year will be reached after the plant is completed in 1958.

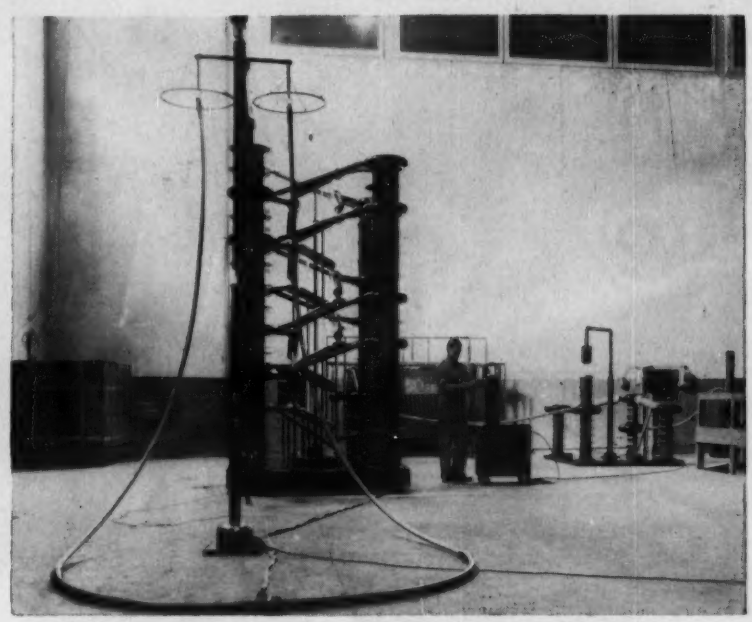
Electric Storage Battery Co has acquired the Atlas Mineral Products Co, located on a 50-acre site at Mertztown (near Allentown), Pa. Atlas manufacturers corrosion-resistant cements and fabricated plastic equipment.

Bailey Meter Co of Cleveland, Ohio has acquired the trade name, know-how, and other assets of Metrotype Corp, Michigan City, Ind. Metrotypes products include systems for data measurement and presentation through analog-digital conversion, telemetering and data logging.

Anthony Co of Streator, Ill., has completed negotiations for the purchase of Truck Crane, Inc., of Chicago. Latter manufactures a hydraulic truck crane of capacities up to 5,000 lb and for mounting in back of the truck cab.

General Electric Supply Co has opened a 12,800-sq ft distribution center at San Jose, Calif., the sixth in the San Francisco district. A. Rohl Barnes is sales manager and Phil E. Paul is store manager.

Thomas Industries, Inc, Chicago, has acquired the plant of Radiant Glass Co, producers of hand-blown glass, at Fort Smith, Ark.



1.4 Mv Generator Installed by Simplex

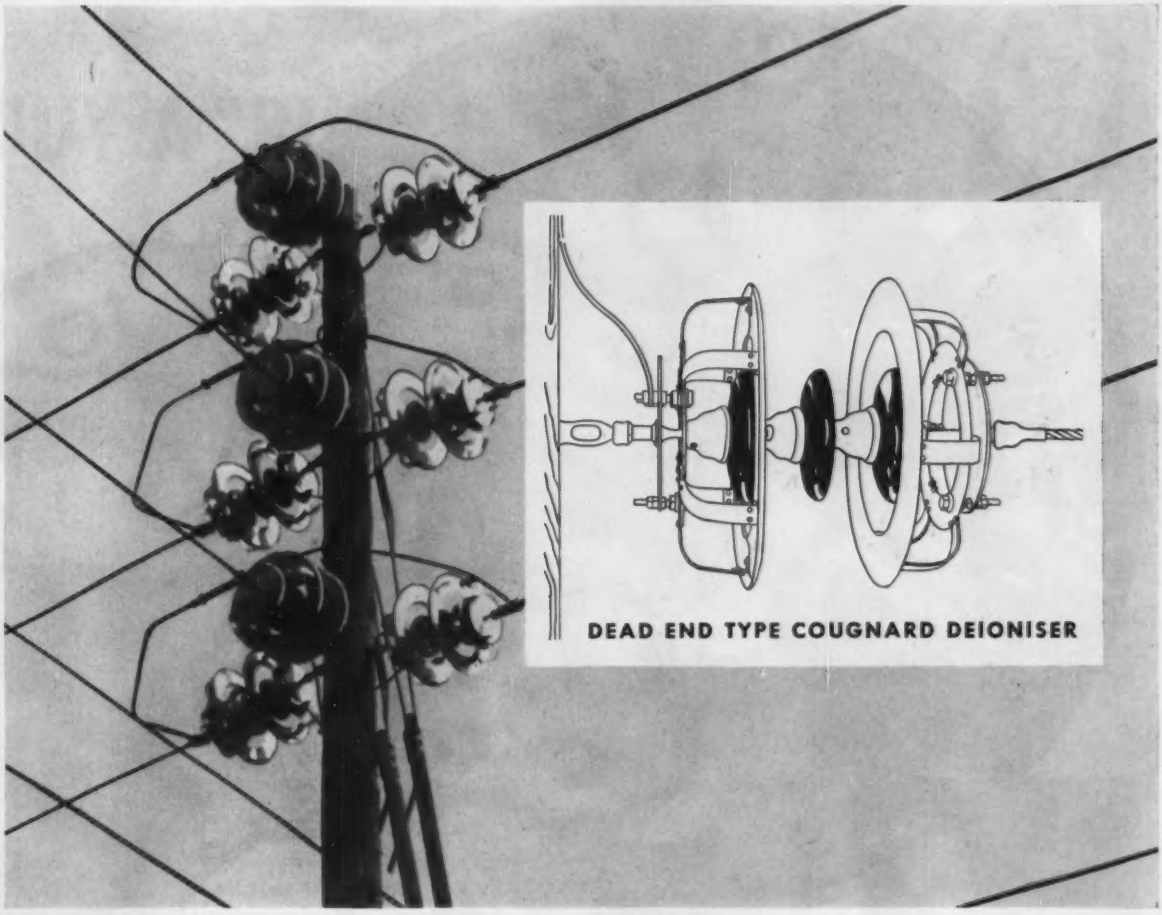
An impulse generator, rated 1.4 million volts with an energy of 16 kw-sec, has been put into service in the High Voltage Laboratory of Simplex Wire & Cable Co, Cambridge, Mass.

With this installation studies will be made covering variations in mechanical construction of cable as well as insulation factors on materials of varying thickness. Investigations will give attention to breakdown properties as a function of time. Work will be correlated with lightning, switching and power surge problems.

Full energy is reported available at 50% and 25% nominal voltage. The design allows for the possibility of impulse current testing. This generator produces standard 1.5/40 microsecond waves although accessories may be added later to produce other wave forms. Oscillographic equipment is employed for visual observations and for photographic recording. Maximum dc voltage is 200,000 which may be changed easily from positive to negative with respect to ground.

This facility is in addition to other high voltage test equipment in the Simplex Laboratory. The impulse generator was supplied by the Instruments Division, North American Philips Co, Inc., Mount Vernon, N. Y.

Referring to the illustration a cable sample in foreground is in position for testing. Adjustments are being made on the generator which applies the triggering impulse. In the background, right, is the dc rectifier unit which supplies charging voltage to the main column of the impulse generator.



Announcing the availability in the United States of the

COUGNARD DEIONISER

—a revolutionary device designed to protect high voltage electric installations against high-frequency atmospheric discharges

The Cougnard Deioniser has been used for years in Europe and Africa with full success. Recent installations in the United States and in Canada have been equally outstanding.

The Cougnard Deioniser is designed for the protection of circuits from 15 KV to 230 KV.

For complete engineering data and full information, write:
Electric Service Works
Delta-Star Electric Division
H. K. Porter Company, Inc.,
Philadelphia 32, Pa.

HKP

ELECTRIC SERVICE WORKS
DELTA-STAR ELECTRIC DIVISION
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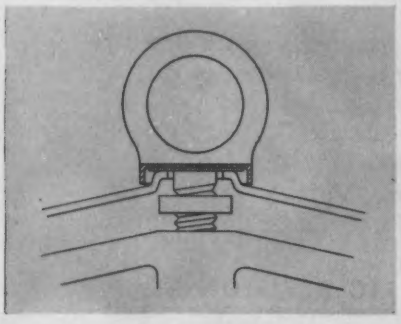
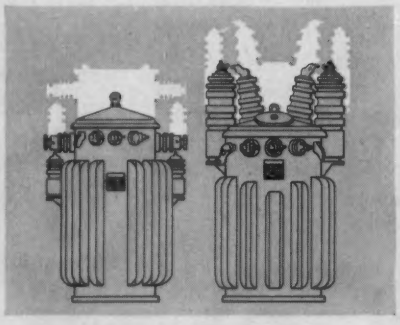
New Offset Breaker Handle . . . on new 1956 CSP transformers identifies new breaker trip settings increasing overload capacity 20%, emergency range 15%.

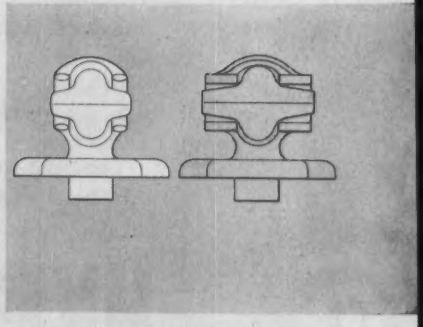
Simpler Overload Monitoring . . . new optional thermal-duty indicator records total overload hours for life of transformer; light and dial easily read from the ground.



Convenient Lifting Eyebolt (3-50 kva) . . . eliminates slings, chains, cable in mounting transformers; saves time. Each transformer gets production line pull-test at twice its own weight.



Exclusive—Reduced Height of All Transformers (15-167 kva) . . . you can replace present equipment with the next larger kva size on the same pole without change in hardware.



New LV Terminals for Aluminum or Copper Conductors . . . larger low-voltage terminal with captive bolt increases contact area, lowers contact resistance.

BUY A "BUSIER" TRANSFORMER...

Eight built-in timesavers give Westinghouse transformers capability to do more

Rating for rating, the Westinghouse transformer works longer while overloaded, giving you time—extra time—to do something about it.

In all new CSP® transformers, operating range has been increased 20%. This has been done without sacrifice of service life of the equipment. There's still more . . . higher breaker trip settings add 15% emergency capacity.

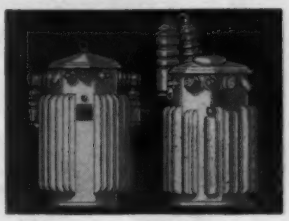
What do you get out of all this? Busier Westinghouse transformers give you more of a breather to make orderly change-outs in growth areas, or to handle unexpected peaks. Or to cope with emergencies in widely scattered places.

Easy and effective load monitoring on the conventional Westinghouse transformer is made possible with the optional new thermal-duty indicator. The indicator keeps tab on overload in two most effective and convenient ways. First, the red light goes on at the overload point. Second, the dial records total overload hours cumulatively. The story that the indicator tells comes straight from coil copper, the only true transformer-temperature indicator.

And what about installation? Below are shown a few of many other new features that simplify the job . . . right up to the time the lineman takes off his gloves.

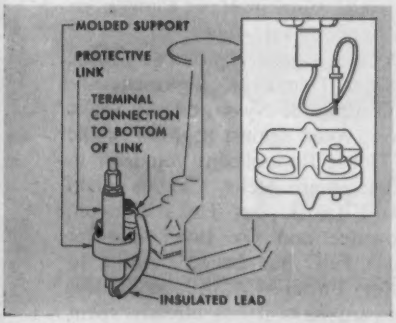
These are the things a really modern transformer can do for you. Call your Westinghouse sales engineer today, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-70769

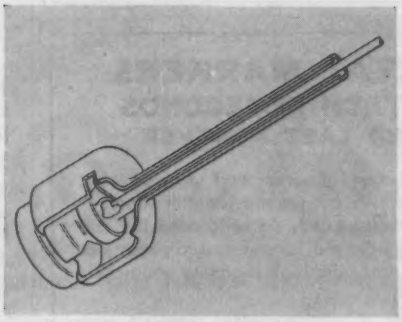


YOU CAN BE **SURE**... IF IT'S

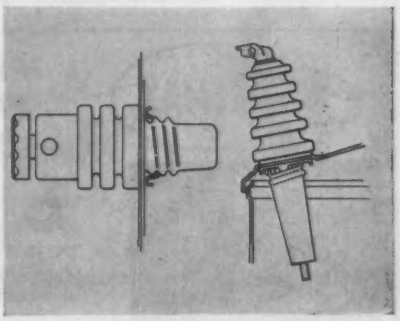
Westinghouse



Faster Change-out of Protective Link on All CSP Transformers—Wall or Cover Mounted... former major repair operation now simple, routine maintenance.



Prevent Line Lockouts due to short circuiting by birds and squirrels; new, optional plastic bird guard; snaps easily over cover mounted high-voltage bushing.



Better Bushing Seal, Simpler Maintenance... internally mounted, threaded high- and low-voltage bushings with spring grip nut.

Just the right capacity for line work...

develops 1500 watts; weighs only 125 pounds; 4-cycle engine power

This workman is drilling holes in a cross arm with power from an Onan 105AK. Unit can also be removed from truck and easily carried to where it's needed.

Onan Model 105AK-1P Electric Plant

This power-packed lightweight plant supplies all the power you need for electric drills, saws and other equipment . . . and for floodlighting on night jobs, too!

Quick-starting, 4-cycle Onan air-cooled engine is direct-connected to Onan all-climate generator in a single, permanently-aligned compact unit.

Four plug-in receptacles, pilot light and carrying frame are standard. Other lightweight portable and mobile Onan plants from 500 to 10,000 watts.

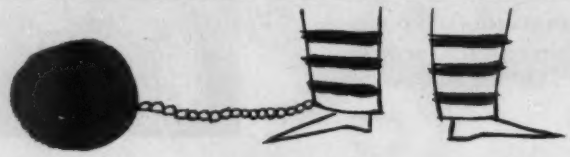
To save time and speed work on construction and maintenance projects, equip your crews with Onan Portable Electric Plants.

Call your Onan distributor or write . . .

Onan ELECTRIC PLANTS

D. W. ONAN & SONS INC.

2973 University Ave. S.E., Minneapolis 14, Minnesota



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Div. CHRISHOLM-RYDER CO. Inc.
5746 Highland Ave., Niagara Falls, N. Y.

SALES ASSIGNMENTS

COMPANY STAFFS

Burndy Corp's Utility-Industrial Division has as its new western manager Lawrence M. Lyons, former manager of the firm's west coast plant. The area includes California, Oregon, Washington, Montana, Idaho, Utah, Arizona, and Nevada.

Graybar Electric Co, Inc, has announced the following appointments: S. A. Faren has been named manager of Grand Rapids office and warehouse; J. T. McGrath and W. E. Boe are new operating managers at Newark (N. J.) and Roosevelt Field (N. Y.), respectively; and W. T. Bronson becomes district sales manager at Queens Plaza (N. Y.) eastern district office.

Hotpoint Co's commercial equipment department has advanced A. J. Green to manager of the Cleveland district. He replaces R. M. Ellis who moves up to sales manager.

Joseph T. Ryerson & Son, Inc, has designated Scott Vrooman as sales manager at its Detroit plant to succeed the late Harold E. Stavers. Bruce D. Clausonthue replaces Vrooman as sales manager at the Chicago plant.

REPRESENTATIVES

Hexcel Products, Inc, has appointed the C. A. Peterson Co of Los Angeles as general sales agents for Honeylite in the territory comprised of Southern California, southern Nevada, and Arizona.

General Electric Co's Metallurgical Products Department has appointed Remco Supply, Inc, of North Carolina, as authorized Carboloy carbide tool distributor for the Winston-Salem, Greensboro, Durham, and Raleigh areas.

Oregon Unit Hits FPC

House of representatives of Oregon legislature voted 37 to 18 to memorialize congress to appropriate money for immediate construction of a high dam in Hells Canyon on the Snake River.

Vote was generally on party lines, but one Democrat, Representative Emil Stunz of Nyssa, on the Snake River, voted against it. Four of the 21 House Republicans voted for it.

The high Hells Canyon dam would knock out Hells Canyon, Brownlee and Ox Bow sites for which FPC has issued permits to Idaho Power Co. Idaho Power company says it has already spent $14 million on the low dam system.

The memorial now goes to the Senate, where it is expected to have tougher going.

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POWER DISTRIBUTION KNOW...

IF IT'S PARANITE IT'S RIGHT!®

FROM POWER TO CONTROL CABLE...

Paranite has earned an unquestioned reputation for quality wire products and dependable service! Overhead . . . or underground . . : there's a Paranite cable specifically engineered to perform in excess of your requirements. Super-Pararite® butyl rubber insulations have been developed to withstand conditions in *your* area. Copper or aluminum bare or weatherproof cables—ACSR or line wire (formerly products of Midland Wire Corporation) are available.

LIVE BETTER ELECTRICALLY

PARANITE WIRE AND CABLE

DIVISION ESSEX WIRE CORPORATION

FORT WAYNE 6, INDIANA

MANUFACTURING PLANTS: ***Birmingham, Alabama; Anaheim, California; Jonesboro, Indiana; Marion, Indiana**

Warehouses* and Sales Offices

*Chicago, Illinois	Hartford, Connecticut	*Newark, New Jersey	Rochester, New York
Cleveland, Ohio	Indianapolis, Indiana	Omaha, Nebraska	*Saint Louis, Missouri
Dallas, Texas	*Kansas City, Missouri	*Portland, Oregon	*San Francisco, California
*Detroit, Michigan	*Los Angeles, California	Upper Durby (Philadelphia), Pa.	Springfield, Illinois

CORROSION-RESISTANT
FASTENINGS
with High Safety Factor

Strict adherence to specifications, interchangeability, dependability, and long service life—these are inherent characteristics of Harper Corrosion-Resistant Fastenings—the accepted standard in the electrical field.

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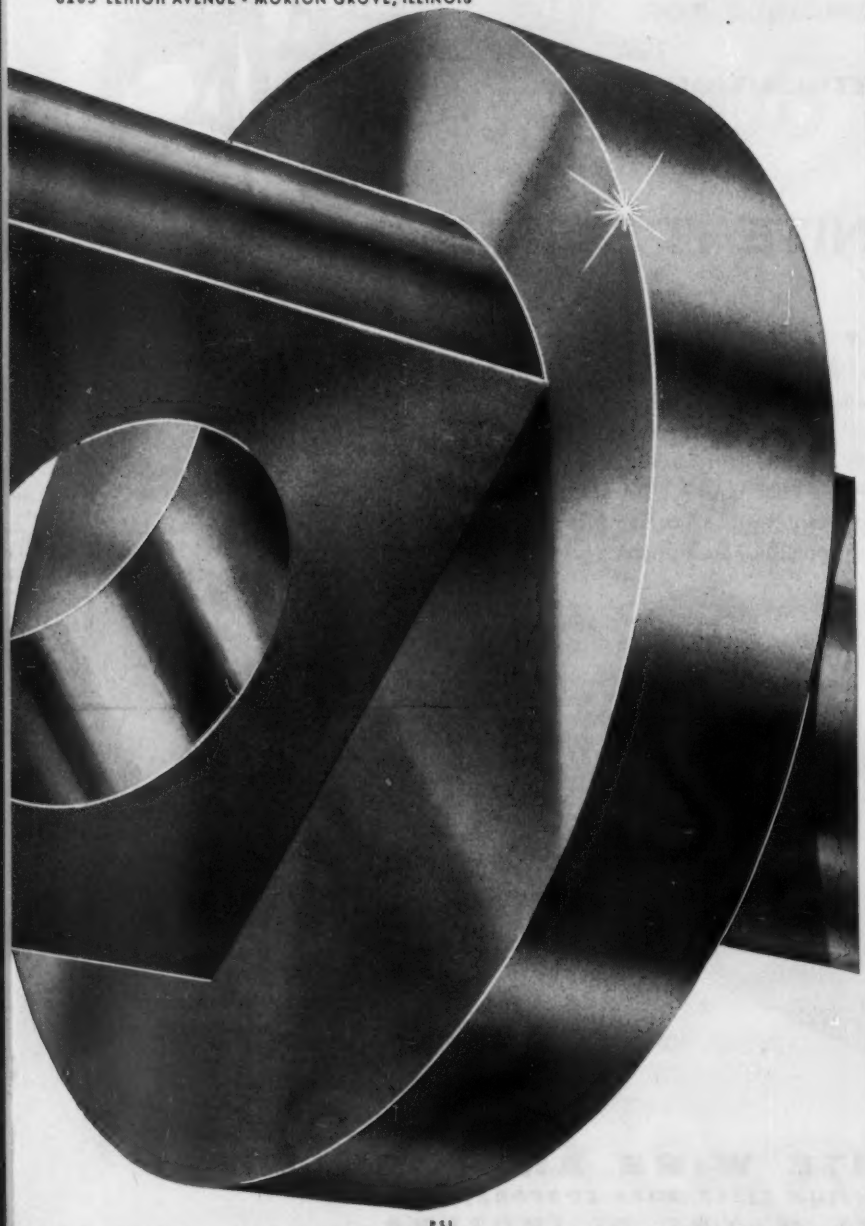
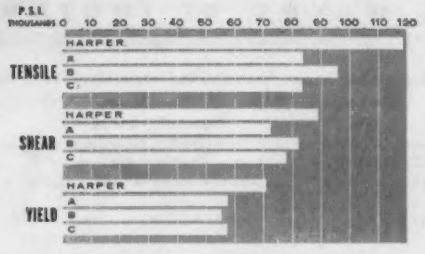


Laboratory tests prove greater strength of Harper stainless steel machine bolts

Independent laboratory tests* on stainless steel machine bolts produced by The H. M. Harper Company and three other leading producers of fastenings, prove Harper superiority in Yield, Tensile, and Shear Strength. Chart shows the actual results of these tests . . . irrefutable proof of Harper superiority! For complete details request Form No. 126.

*By R. W. Hunt Laboratories



What Is an Industrial Customer Worth?

(*Continued from page* 76)

voltage for a customer with a certain maximum demand. For example, revenue from a customer with a maximum demand of 3,000 kw and an annual consumption of 10 million kwhr, corresponding to a load factor of about 38%, would be $145,000 per year. Justified investment, as indicated on Figs 1 and 2, would be $267,000 at 69 kv but only $110,000 at 34.5 kv. The investment supported is 1.8 times the revenue at 69 kv and only 0.75 times the revenue at 34.5 kv. In either case, the "three-times-revenue" rule would overstate the justified investment.

Revenue from a customer with a maximum demand of 500 kw and an annual consumption of 2 million kwhr, corresponding to a load factor of approximately 46%, would be about $33,000. Investment justified, as indicated on Figs 3 and 4, respectively, would be $70,000 at 34.5 kv and $38,000 at 12 kv. The lower demand and higher load factor raises the investment-to-revenue ratio to 2.1 to 1 and 1.2 to 1, respectively. Under the conditions on which these charts are based, the 3:1 ratio would apply only to customers requiring close to 500 kw., supplied at 34.5 kv, and having a very high load factor.

This last example may also illustrate the economic implications of service at these two voltages. Cost of substation and metering equipment for 500 kw is about $17,000 at 34.5 kv and $8,000 at 12 kv. The balance of the justified investment, namely $53,000 at 34.5 kv and $30,000 at 12 kv, is available for spur line and local reinforcements. The $23,000 difference may well justify building a longer spur line to connect this customer to the 34.5-kv system, and later may save several times this amount when 12-kv plant is required for general use.

Obviously, the least expensive solution is not always the most economical one. One should not be induced by the lowest immediate investment to connect a customer to the nearest line or or substation having spare capacity, irrespective of the voltage and possible future needs of the area.

Walkie-Talkie Automation

Vincent Rosato, instrument mechanic checks readings on steam flow transmitter with the control room two floors below by walkie-talkie. The transmitter is part of a highly automated system designed and installed by Penn Instruments Division of Burgess Manning Co at the new Sayerville plant of Jersey Central Power & Light Co.

Electric Overhead Crane Institute Elects Officers

Electric Overhead Crane Institute, Inc, has elected the following officers:

President—Herbert T. Florence, executive vice president, Cleveland Crane & Engineering Co, Cleveland, Ohio.

Vice President—Frank M. Blum, general sales manager, Industrial Division, Harnischfeger Corp, Milwaukee, Wis.

Executive Secretary and Treasurer—Joe H. Peritz (re-elected)

General Counsel—C. M. Dinkins

Institute offices are located at One Thomas Circle, Washington 5, D. C.

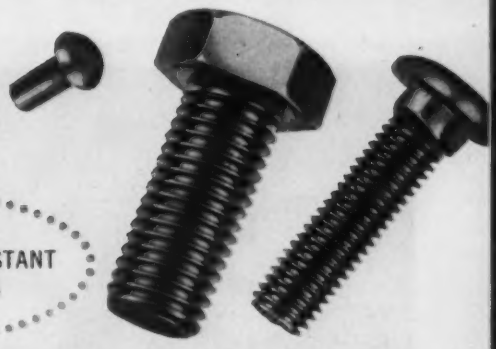
Manufacturers' Notes

Robertshaw-Fulton Controls Co., is acquiring two firms. The Beta Corp of Richmond, Va., manufactures vibration monitoring equipment for rotating and reciprocating machines. Its operations will be consolidated with Fielden Instrument Division at Philadelphia, Pa. And, an agree-

(*Continued on page* 164)

HARPER®

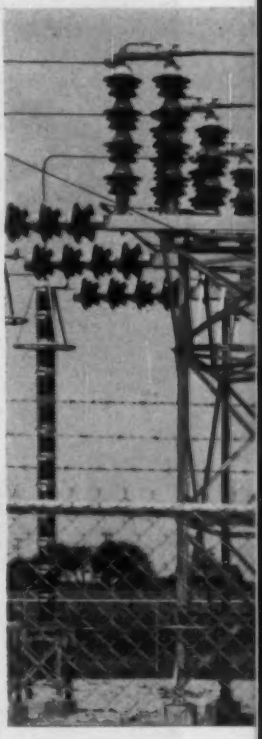
CORROSION-RESISTANT FASTENINGS



WHAT SPECIAL PART DO YOU NEED?

Let Harper Flo-Form save you time, money, metal!

Only Harper, with its vast experience in corrosion-resistant fastenings, could develop Flo-Form—the copyrighted name for an exclusive process that turns out problem specials *better, faster,* and at *lower cost!* Call your nearby Harper Branch and outline your *"special problem"* to a Harper Application Engineer. See how quickly the team of Harper engineering, metallurgical, and tooling specialists speeds the right answer to you. See how Harper Flo-Form produces a cleaner, stronger, better special . . . faster . . . at lower cost! Draw upon our thirty-three years of know-how. Send your problem to The H. M. Harper Company, *today!*



THE H. M. HARPER COMPANY

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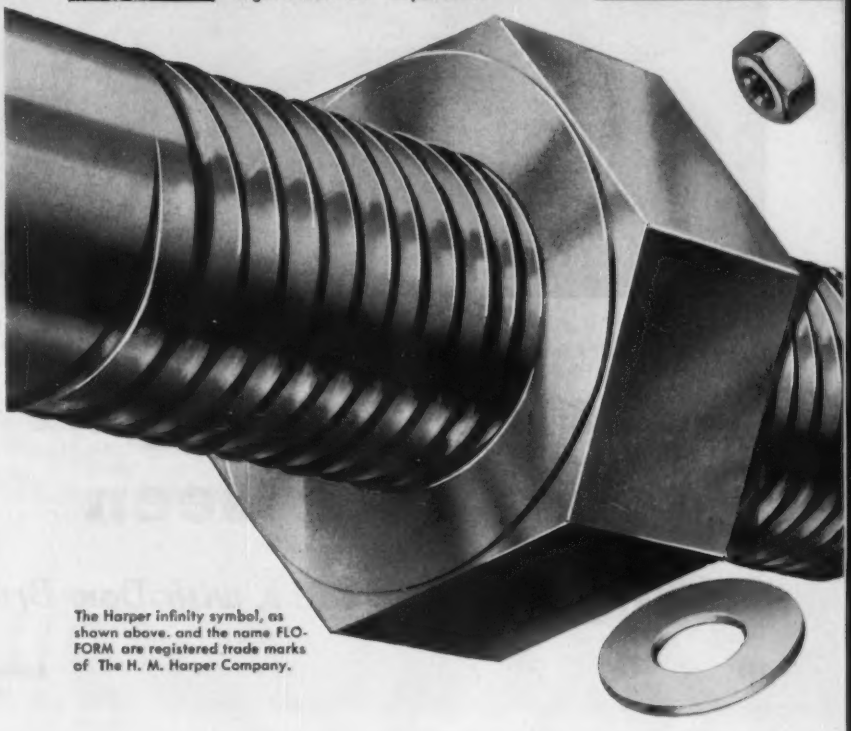
Meet Harper Application Engineer, JAMES TURNBULL

Mr. Turnbull is typical of Harper Application Engineering Service. From the Harper Branch in New York City, he works with industry throughout Metropolitan New York. Important service by Mr. Turnbull includes daily solutions to special problems, through hand-in-glove work with Harper users.



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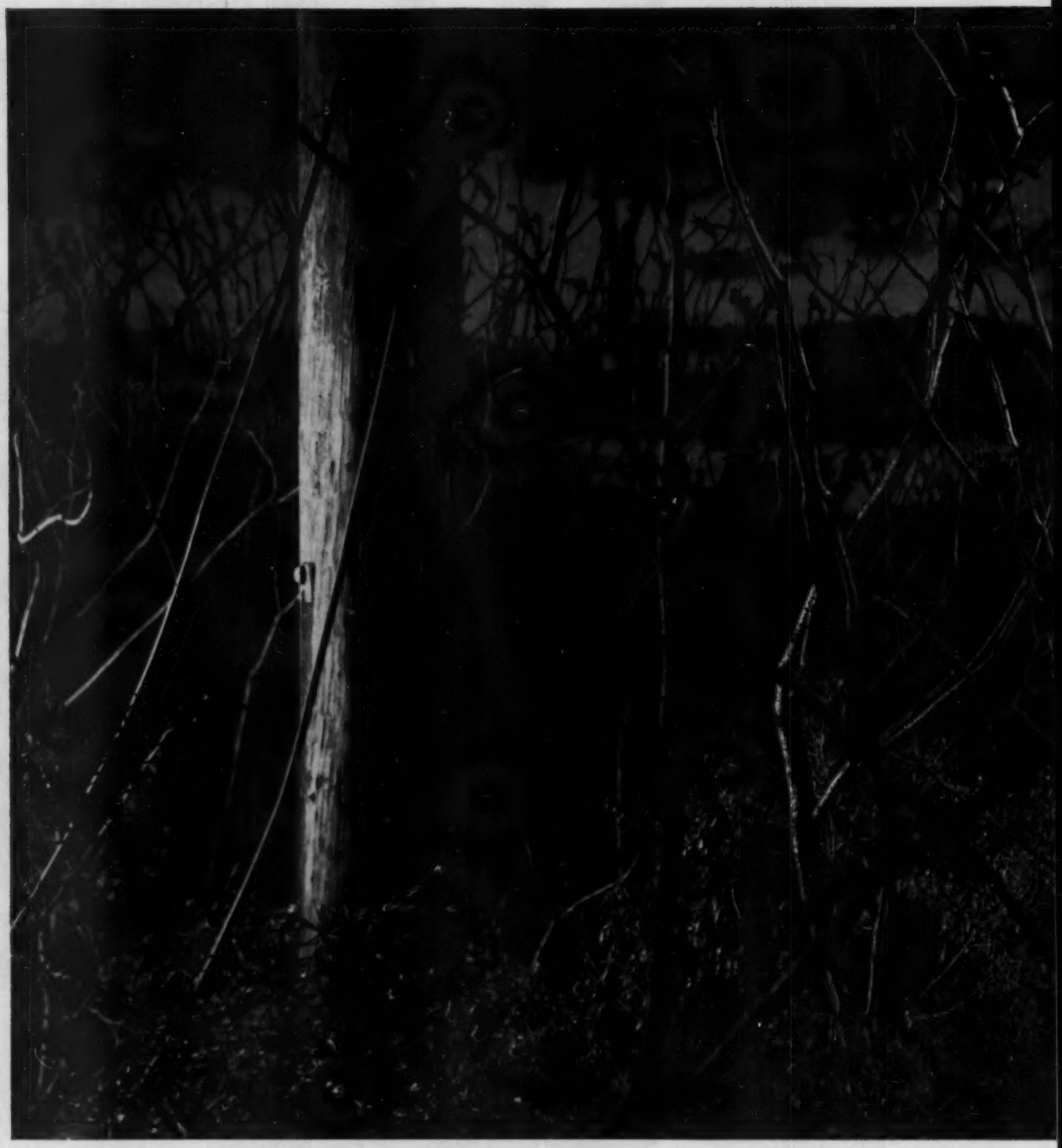


The outage that could have been shortened ... *with Dow Brush and Weed Killers*

The trouble call came in at 10:25. The crew reached the scene in seventeen minutes.

From that minute on, they found good reason why Dow brush and weed killers should have been there before them. The first stab of the truck spotlight showed a tangle of undergrowth

that meant the wait for restored power had only started.

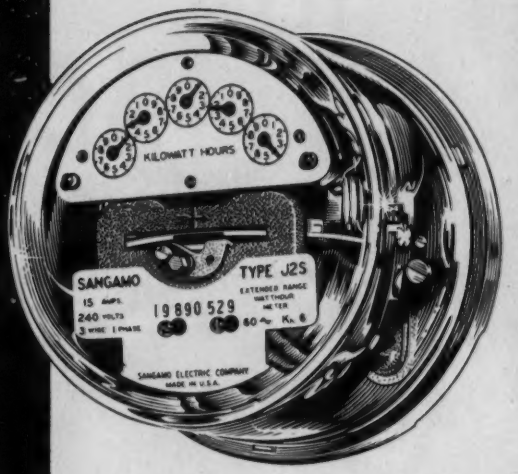
The same spring thunderstorms that had kept them hopping for weeks had jumped weeds waist-high and jungle-thick. Thriving brush and trees made the right of way no place for this repair crew in a hurry.

Their next trouble call can be different . . . thanks to Dow brush and weed killers. Esteron* 245, Kuron* and Esteron Brush Killer can clear the right of way of brush and trees. Radapon*, containing dalapon, controls grass all year long. Baron* levels many broad and narrow-leaf weeds with one treatment.

Wherever you're faced with unwanted vegetation, we can help you solve the problem the modern, chemical way. This sure, cost-saving control is waiting for you now . . . at Dow. Write THE DOW CHEMICAL COMPANY, Industrial Section, Agricultural Chemical Sales Dept., Midland, Mich.

Trademark of The Dow Chemical Company

YOU CAN DEPEND ON DOW



Don't take OUR word for it....

LOOK TO YOUR OWN RECORDS

for proof of watthour meter performance!

For all the *facts* about watthour meter performance—how your meters stand up in actual service... how accurately they retain their calibration... how many are damaged by high voltage surges... how quickly and economically they can be put back into service... and what it costs to keep meters on the line—there's no source more reliable than the meter accuracy records of your own Meter Department. These unbiased records are kept for your information as a company executive.

Sangamo J2 Meters provide:

ACCURATE MEASUREMENT from the lightest loads to 100 amperes for the entire life of the meter.

HIGH INSULATION LEVEL to withstand high voltage surges without damage.

CORROSION-RESISTANCE for optimum performance in humid, salt-laden or corrosive atmospheres.

LIFETIME BEARING SYSTEM—proved by millions of Sangamo Meters in service.

PLUS SLOW SPEED! Only ten disk revolutions per minute at full nameplate rating... another reason why the J2 is your best investment in a watthour meter.

SANGAMO ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

JM57-2

ELECTRICAL BUSINESS OUTLOOK

Electrical World
FEBRUARY 18, 1957

Stock market skittishness this year has left some readers of financial pages with gloomy concern over prospects. But more tangible indicators suggest, while business may level off, there is no recession in the cards for '57.

The durable goods sector looks weaker than it did a year ago. Commerce Department reports show that manufacturers' orders for durables in December were 5% (seasonally adjusted) under November. A drop in orders now will not affect production much this year.

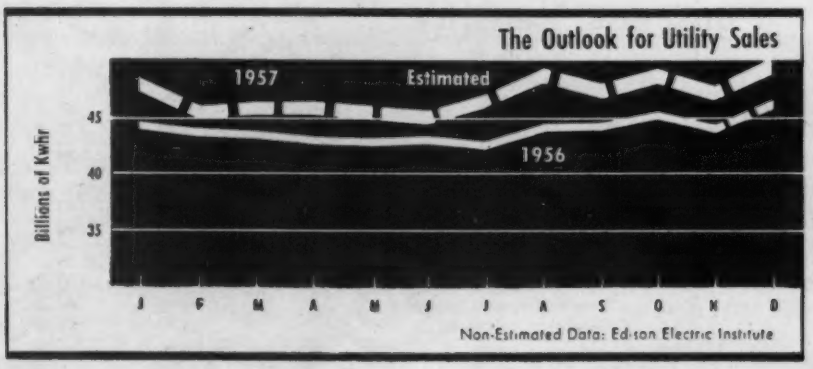
Dollar volume of construction looks as if it will top last year, though physical volume may be a shade lower. Highway construction will be rising for several years. Industrial building contracts mounted sharply last year and will call for increasing activity through 1957. Residential housing, especially the part that depends upon Government credit, is the weak spot. Requests for both VA appraisals and FHA applications for mortgage insurance have been trailing off. And the Government shows no signs of real easing in housing credit policy.

In other sectors the outlook is strong. Commerce reports that orders for nondurables have been coming in steadily and in December were 5% over a year ago. Government spending on Federal and local levels will run $5 to $6 billion over last year.

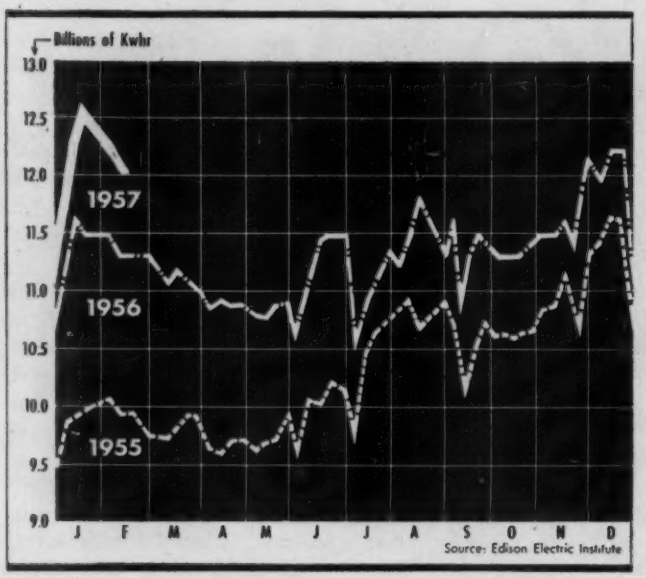
Sales of consumer goods, which account for about ⅔ of all business, are certain to rise in line with consumer income. Consumers earned income at an annual rate of $333.5 billion in November and December. That's a peak in consumer earnings. There are strong indications income will pick up even more this spring. Labor Department offices report industry is planning to step up employment.

Coming soft coal rises will add about $35 million to electric utility fuel bills this year. Coal producers are currently considering boosts in the neighborhood of 25¢ a ton. The reason: Last October's labor package raised miners' wages $1.20 a day, following which coal prices rose up to 40¢ a ton. Second half of the package is due this April. It will hike wages 80¢.

Meanwhile, oil prices are pressuring Florida utilities to appeal for drastic measures. Officials have asked for temporary government controls to halt a cycle that's raised residual an average of 75¢ a barrel since November. McGregor Smith, Florida Power & Light Co board chairman, said coal company deals are being studied and the company's nuclear power activities have been stepped up as alternatives to the oil price squeeze (page 65).



STATISTICS



OUTPUT

Week ended Feb. 9, 12,019,000,000 Kwhr Up 6.0%

Per Cent Change From Previous Year

	Jan. 26	Feb. 2	Feb. 9
Total U. S.	+ 7.8	+ 6.8	+ 6.0
New Eng.	+ 6.5	+ 4.3	+ 5.3
Mid. Atlan.	+ 4.8	+ 4.5	+ 4.7
Cent. Ind.	+ 5.9	+ 6.0	+ 5.8
West Cent.	+ 8.7	+ 9.9	+10.0
Southeast	+ 7.4	+ 4.8	+ 4.5
South Cent.	+11.5	+11.6	+13.3
Rocky Mount.	+12.8	+10.3	+ 6.1
Pacific			
NW	+16.8	+ 9.2	− 2.5
SW	+ 9.0	+11.1	+11.6

Seasonally Adjusted Index 226.7
Week Ago 230.4
Year Ago 213.1

Atomic Energy Commission requirements—1,150,000,000 Kwhr (Electrical World estimate). Excluding AEC, output increase was 6.4%.

Power Statistics . . .

		Latest Month	Preceding Month	Year Ago	Annual Change %
Capacity	Nov.	119.91	119.38	113.55	5.6
Peak—Class 1 Systems	Oct.	101.2	96.6	96.5	4.9
Estimated Dec. '56 Peak (million kw)	Nov.	106.2	106.2	104.5	1.6
Estimated Dec. '57 Peak (million kw)	Nov.	114.8	114.8	111.6	2.9
Production—billion kwhr	Nov.	50.65	51.13	47.78	6.0
Hydro		9.31	9.24	9.24	0.8
Fuel		41.34	41.89	38.54	7.3
Sales—billion kwhr	Nov.	45.78	45.98	42.96	6.6
Residential		11.66	11.27	10.74	8.6
Commercial		7.20	7.37	6.61	8.9
Industrial		24.51	24.79	23.28	5.3
Other		2.41	2.56	2.33	3.4
Fuel Consumption	Nov.				
Coal—million tons		14.03	13.52	13.31	5.4
Oil—million barrels		7.13	6.27	7.11	0.3
Gas—million cu ft		88.73	114.36	81.75	8.5
Net Income Class A & B Co's—$ million	Nov.	102.54	95.79	102.79	−0.2
Residential Customers—millions	12 mos.	45.62	45.49	44.30	3.0
Revenue per kwhr	ended	2.60¢	2.60¢	2.65¢	−1.9
Avg kwhr per customer	Nov. 30	2,956	2,942	2,728	8.4
Avg annual bill		$76.86	$76.49	$72.29	6.3

Business Statistics . . .

Indexes: 1947–49 = 100					
FRB Industrial Production	Nov.	149	150	144	3.5
ENR Construction Cost	Jan.	148.4	147.6	141.8	4.7
BLS Cost-of-living	Dec.	118.0	117.8	114.7	2.9
New Orders for Machinery (1950 = 100)	Nov.	140	139	143	−2.1
NEMA Sales					
Insulation materials	Nov.	149	163	155	−3.9
Electric appliances		81	94	88	−8.0
Wholesale prices	Nov.				
Motors and generators		140.1	136.9	127.0	10.3
Transformers and regulators		146.6	144.8	129.2	13.5
Switchgear and fuses		164.4	161.9	145.9	12.7
GNP—annual rate—$ billion	3rd Qtr.	413.8	408.3	396.8	4.3

MANAGEMENT BULLETIN

FINANCE

Another lull in the security offering market for electric utilities was experienced last week. The underwriting group winning the $30 million Potomac Electric Power Co debentures is shown on page 21. But the rest of February and all of March will be a pretty busy time for the underwriters.

Connecticut Light & Power Co sets subscription price of $16.50 a share on the 927,598 common shares being offered holders on a 1-for-7 basis, record Feb. 11 to expire March 6 without underwriting.

"Statistics of Electric Utilities in the U. S." by the Federal Power Commission is now available. For copy write FPC, Washington 25, D. C.; order number FPC-124; price $6 a copy.

Western Light Telephone Co stockholders took 59,999 shares of 65,568 shares of 5.20% conv. $25 par preferred stock offered on 1-for-8 basis at $25 a share. Balance 5,569 shares were taken by the underwriters, Dean Witter & Co group.

Partly as a result of membership in the Puget Sound Utilities Council, Tacoma Public Utility Board has been advised by Dean Barline, Tacoma director of utilities, that Tacoma, Wash., City Light was able to earn some $92,383 last fall. A temporary surplus of water which followed heavy rains made it possible for Tacoma to send energy to Puget Sound Power & Light Co and the pool.

Montana-Dakota Utilities Co asks Wyoming Public Service Commission approval to assume liability for mortgage notes to be issued by Dakota Electric Cooperative, Inc, totaling $870,000. Funds from the notes, which are to be issued to the federal government, will be used to build a substation at Glenham, S. D., which will be erected by Montana-Dakota. Upon payment of notes, substation will become the property of the company, in accordance with operation agreements with the co-op.

REGULATION

Pennsylvania Power & Light Co has accepted Public Utilities Commission's orders requiring company to make refunds of $9.2 million to its customers. PP&L's Pres Chas. E. Oakes, announced that in making refunds, and instituting the lower rates, the utility was complying with the July 16 and Nov. 20, 1956, orders of the PUC. Company decided not appeal the case to higher courts.

Village of Bloomington, Minn., petitions for a comprehensive revision of state and local regulation over electric and gas utilities. Among other things, the petitions asks for an appointed, rather than elected, regulatory commission; and the establishment of reasonable and uniform franchise taxes on utility systems to be collected by local government units.

LEGISLATION

Existence of the Washington State Power Commission is in the hands of the state legislature, with introduction of a bill calling for abolishment of the commission. Bill was filed shortly after Gov Albert D. Rosellini, in his inaugural address, indicated that the commission was one of several that might be eliminated or consolidated with another department.

Two new public service commissions proposed. The first was proposed in a bill introduced in the Iowa legislature which will regulate all utilities, both privately and publicly . . . The other was proposed in the New Mexico legislature. A constitutional amendment and accompanying statute have been introduced to provide a new public utility regulatory body.

Bill to permit Sacramento Municipal Utility District to issue up to $10 million in revenue bonds to finance expansion of SMUD distribution system has been introduced in the California legislature.

MANAGEMENT BULLETIN continued

Utility area dispute revived in Arkansas. Legislature gets bill which will freeze the service areas now allocated between private power companies and rural electric co-ops.

New York State legislature gets bill which will strip State Power Authority of rate-fixing powers for electricity developed from the St. Lawrence and Niagara projects. Measure will give the PSC the right to fix rates. It now regulates rates of other utilities in the state.

TAXES **Criticism of county assessment of inter-county utilities** and "hidden" municipal utility taxes in Florida has been expressed in a report submitted to the State Citizens Tax Council by Dr W. F. Dillingham, economics professor at Florida State University, on a study of electric, gas, telephone, and truck and bus company taxation. Municipal utility taxes "without excessive profit taking" is not condemned, Dr Dillingham said, adding that profits of city-owned utilities should be sufficient to cover the amount of property taxes that private companies would pay.

YOUR HEALTH

Asthma: Often Traced to Allergy

REX H. WILSON, MD, Medical Director, B. F. Goodrich Co

He was admitted to the hospital in an acute asthmatic attack. He was forced to remain in a sitting position, leaning forward, to breathe. He was allergic to certain foods and to ragweed pollen. The probable reason for this severe attack was a lung infection which had aggravated the asthma. He was placed in an oxygen tent and given medication. Within a few hours he was able to lie down in bed. He was able to leave the hospital in 10 days.

Asthma is a symptom complex. It probably is due to a reaction of the lung tissue to specific substances to which the person is allergic. Along with mental and glandular disturbances, infection is an aggravating influence in asthma, but most cases are the result of allergy to foods and inhaled substances.

The basic disturbance is an obstruction of the air passages in the lung. These passages become swollen and narrowed, making breathing difficult. The rate of lung air flow is reduced. Air is trapped in the lungs and cannot be expelled.

Suffocation is the cause of death during an asthmatic attack. The lungs are blown up and the air passages are plugged with thick secretions.

An asthmatic attack is preceded by a sense of fullness in the chest and wheezing. Breathing becomes labored with a short gasping sucking in and a long forced expelling of air. Coughing occurs, producing a large amount of thick sputum.

The cause of asthma must be determined to treat it properly. History, physical examination, skin tests and x-rays of the chest provide many clues. Food allergy is a common cause.

Wheezing also may be caused by chronic bronchitis, heart disease, a foreign body in the lung, an enlarged thyroid gland, or a cancer of the lung. Dust irritation of the lungs, tuberculosis or an aortic enlargement can cause difficult breathing.

For specific treatment, desensitization against the substances to which the individual is sensitive, control of where and how the patient lives, and the elimination of the offending foods or other agents, are necessary. Ephedrine, aminophylline, adrenalin and the cortisone preparations are effective. Sedatives relieve the apprehension and tension. Morphine is never used, because it depresses breathing. Expectorants and antibiotics are of value.

Patients with severe asthma are better off in a hospital. The direct examination of the air passages with a bronchoscope and the removal of obstructing plugs may be life saving. Oxygen may be useful. Fluids into the vein may be required.

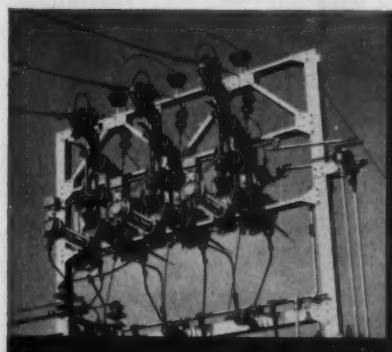
The prevention of further attacks is important. Small doses of a sedative will quiet the patient. An adrenalin nasal spray can be used at home. Medicated rectal suppositories are of particular value.

Breathing without wheezing is an asthmatic's prayer. It can be realized only by examination, medication and desensitization.

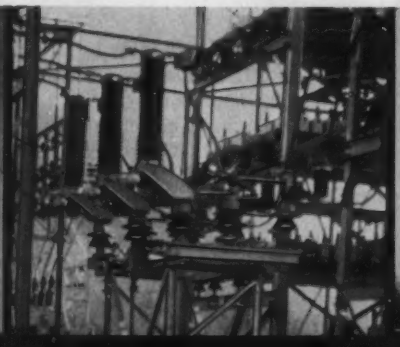
A Field Experience Report from Schwager-Wood Corp.

FIRST in VACUUM SWITCHES

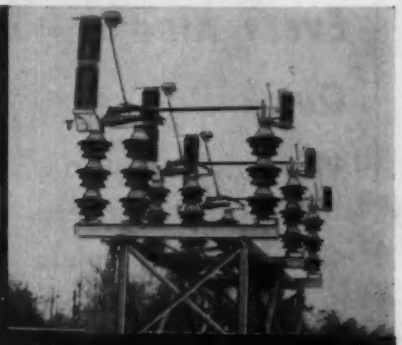
Proved in a wide range of installations



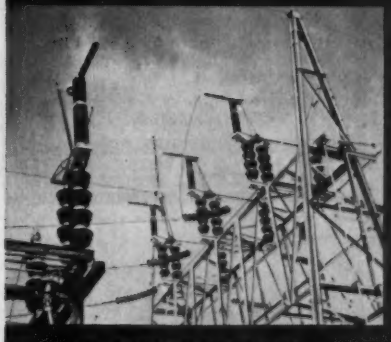
15 KV CAPACITOR SWITCHING



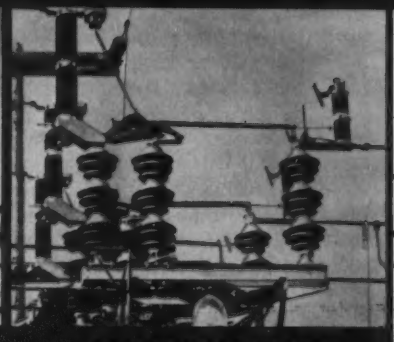
23 KV CAPACITOR SWITCHING



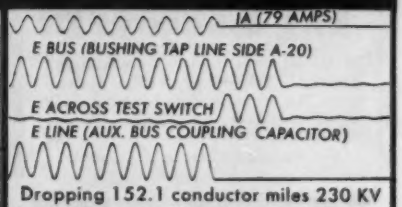
115 KV CAPACITOR SWITCHING



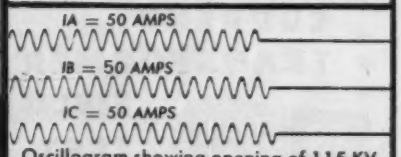
161 KV LOAD SWITCHING



115 KV CAPACITOR SWITCHING



Dropping 152.1 conductor miles 230 KV line by Schwager-Wood Vacuum Switch.



Oscillogram showing opening of 115 KV-10,000 KVAR capacitor bank by Schwager-Wood Vacuum Interrupter Switch.

Schwager-Wood advances technology of power transmission in pioneering new vacuum interrupter switch.

Learn the amazing facts about the new Schwager-Wood vacuum interrupter switch — a development by Schwager-Wood. Experience indicates a whole new concept of high voltage current interruption. Major economies are possible over previous methods.

Write for Bulletin No. 9a. Outstanding applications of Schwager-Wood vacuum interrupter switches are interruption of load and line charging currents and the switching of large banks of capacitors.

This development is another example of the forward thinking and competent workmanship represented in all Schwager-Wood high voltage switch-gear. Prompt personal attention is given to all requests for technical information on these switches and all other Schwager-Wood electrical equipment.

SCHWAGER-WOOD CORP.

MANUFACTURERS OF HIGH VOLTAGE ELECTRICAL EQUIPMENT

8024 S.W. 35th AVENUE, PORTLAND 19, OREGON

Representatives in Major U. S. Cities

STEEL

Every Kind

Quick Delivery

Plates, Structurals, Bars, Sheets, Tubes, etc. Carbon, Alloy, Stainless Steels, Babbitt Metal.

RYERSON

Plants at: New York • Philadelphia Boston • Wallingford, Conn. • Charlotte, N. C. • Cincinnati • Cleveland Detroit • Pittsburgh • Buffalo • Chicago Milwaukee • St. Louis • Los Angeles San Francisco • Spokane • Seattle

CURRENT TRANSFORMER FIELD TEST SET

NEW!

- Check your current transformer installation quickly with this NEW TESCO instrument; pinpoint sources of possible trouble in short-circuiting, faulty connections, instrument tampering, and grounding.
- A special new feature now available in this instrument is the spread of resistance burdens — .5, 1, 2 or 4 ohms. The lower burden values are recorded for testing the small size low capacity current transformers, which are widely used on low voltage installations.
- 2½" panel instrument is easily read. Transparent unbreakable plastic cover. Overall dimensions 6⅞" x 5¼" x 3⅛" high. Weight 2¾ pounds.

EASTERN SPECIALTY CO.
PHILADELPHIA 40 PA.

- *For full information,*
- *write for Bulletin No. 54-B*

Manufacturers' Notes

(*Continued from page* 155)

ment has been reached to acquire the assets and business of Aero Manufacturing Co., manufacturer of switches and house heating controls, with plants at Columbus and Hillsboro, Ohio.

UCC—Union Carbide and Carbon Corp has formed the Union Carbide Research Institute for extending basic research. The institute will be located on UCC property near Tarrytown, N. Y. It will have 40 laboratory modules and the facilities are expected to be completed by Spring of 1958.

Mueller Electric Co, Cleveland, Ohio has produced its 300 millionth clip in its 48th year. Ralph Mueller, founder of the 48-year old company, said only 7 years were needed to produce the third 100 million, and he expects in 5 years or less to make the next 100 million.

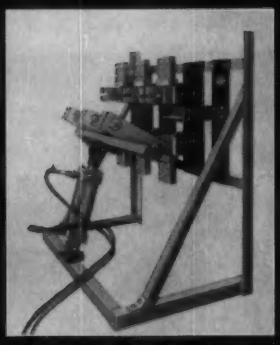
WacLine, Inc., of Dayton, Ohio, has entered the electrical indicating instrument field to supplement its line of electrical indicating and controlling tachometer generators, and motor drives. Several of the key people were former employees of Burlington Instrument Co. which was purchased by another company in February 1956.

Stewart-Warner Corp, Chicago, will distribute its line of electronic industrial balancing equipment through a department headed by Ralph Buscarello at Chicago. The equipment was formerly marketed by Merrill Engineering Laboratories of Denver.

Celanese Corp of America will have in operation approximately in March a 40-million-lb-a-year plant for making polyolefin resins near Houston, Texas. The resin known as Fortiflex is in the group of plastics referred to as "low-pressure polyethylenes," and is reportedly applicable to wire and cable insulation.

3M—Minnesota Mining & Manufacturing Co, St. Paul, Minn., reported sales increased by more than 15% in 1956, totaling about $325 million, compared to $281 million for 1955.

New AIR OPERATED INDOOR DISCONNECT SWITCH by BARKELEW



200 TO 12000 AMPS
250 TO 15000 VOLTS

A new air-operated indoor disconnect that can be conveniently and safely operated by remote control. Available in single and double throw.

Write Dept. B for more information.

BARKELEW ELECTRIC MFG. CO. MIDDLETOWN, OHIO

Are you missing something in Electrical World?

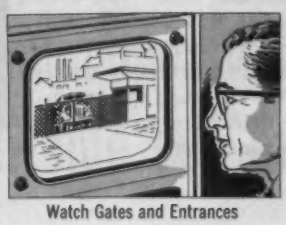
Right now, have a look at the complete, compact, 2-minute summary of the book, printed on special yellow stock at the front. Here is *the gist* of what's going on in the industry! "Newscope" covers future and late news; "Electrical Week" examines events, generation, distribution, commercial, management, people, manufacturing, and new equipment; "Engineering Trends" briefs *that* aspect of issue content. This specially written summary in the front of each issue, on yellow stock for easy finding, gives you *the complete overall picture of the industry and everything affecting it for the past week!* It mirrors the contents of each issue for absorption almost at a glance – let's you invest your Electrical World reading time more profitably.

Pin-Point Control for Plant and Property Protection

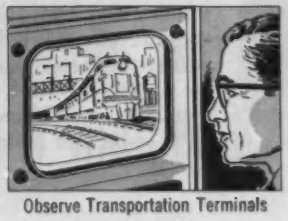
...with High-Definition

PHILCO *Industrial TV*

Survey Storage Areas

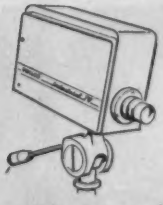


Watch Gates and Entrances



Observe Transportation Terminals

Watch for Fires



Compare the picture clarity of Philco Industrial TV before you order ANY closed-circuit system. Here is picture quality and detail that's excellent . . . even for applications where ITV never could be used before.

From a central control point, one employee can guard your entire premises . . . maintain round-the-clock surveillance of even the most hazardous or inaccessible locations. And operating cost is negligible . . . Total hourly power consumption for an entire system actually amounts to less than the price of a pack of cigarettes or an ice cream soda.

Virtually any combination of on-the-spot cameras and centrally-located monitors can be used. You can quickly mount an inexpensive, lightweight Philco Vidicon camera to cover each important field of vision in your security and protection network. Philco's complete line of accessories permits maximum flexibility for your system. Remote pan and tilt . . . remote iris and focus . . . Auto-Zoom lenses . . . lens turrets . . . weather-proof housings . . . explosion resistant housings . . . assure complete versatility and adaptability to any installation.

To pin-point property protection for your company . . . examine . . . compare . . . specify Philco ITV.

Send for illustrated brochure, describing Philco ITV.

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GOVERNMENT AND INDUSTRIAL DIVISION
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PP&L Advances Campbell

Newly appointed general superintendent of Pennsylvania Power & Light Co is Daniel A. Campbell, Jr. He succeeds Warren J. D. Geary, who has retired after serving in that position for ten years.

Campbell has been superintendent of operation at Hazelton since last year. He joined PP&L 35 years ago, shortly after his graduation from Pennsylvania State University as an electrical engineer. After a number of promotions he was appointed assistant superintendent of the Lehigh Division operating department at Allentown in 1939. He became superintendent of that department in 1942.

Campbell was advanced to assistant to the superintendent of lines and substations at Hazelton operating headquarters in 1948 and three years later was named superintendent of lines and substations.

Geary is a veteran of 45 years of service with the utility and predecessors and held numerous positions of responsibility with PP&L.

DANIEL A. CAMPBELL, JR.

Rodger and Winsborough Elected to VP Posts

MALCOLM R. RODGER

M. R. Rodger and R. M. Winsborough have been elected vice presidents of Middle West Service Co.

Rodger formerly served as senior marketing consultant. He will continue as principal consultant on sales promotion, marketing, and new business programs.

Winsborough, who has been with the firm since 1938, continues in his capacity as principal consultant in the fields of industrial and public relations, personnel, and employee training and relations. He was formerly with Southwestern Gas & Electric Co as commercial manager and a director. An engineering graduate of Rice Institute, Winsborough was instrumental in establishing ECAP and co-authored "The American Economic System."

ROBB M. WINSBOROUGH

Torvinen Becomes Treasurer

Roy Torvinen, long-time employee of Sierra Pacific Power Co, has been appointed treasurer of the company, replacing H. P. Dayton who retired from that office earlier this year.

Torvinen has been with Sierra Pacific since 1930 when he accepted the post of chief clerk. Ten years later he was promoted to assistant secretary and in 1942 advanced to assistant treasurer. He was named company secretary last Feburary. The appointment as treasurer followed 11 months later.

Before coming to Sierra Pacific, Torvinen was with Puget Sound Power & Light Co for nine years and served there as accounting clerk and later as chief clerk.

R. A. Holdcraft will now assume the position of assistant treasurer vacated by Torvinen. He has been assistant secretary for the past year.

ROY TORVINEN

Dispatchers of Northern States Power Company in Minneapolis have a running picture of load conditions across the company's 40,000 square mile area. Bell System private line channels carry data fast and accurately from all over the system to the operations center.

How Bell System communications serve the power industry

Modern communications help Northern States make profitable use of a million-KW capacity

Bell System private line channels tie the power networks serving homes and industries in 527 upper Midwest communities to the new system operations center of Northern States Power Company in Minneapolis.

The slightest fluctuation in output, increase in load, or the first signs of bad weather are transmitted directly to the center, giving NSP dispatchers plenty of time to adjust spinning reserve capacity.

Bell System channels for telemetering, and supervisory control (which permits remote control of generation from the center), form the nerve system that lets NSP give efficient, economical power and light to 2,000,000 people.

Your Bell Telephone representative is your best source of ideas on how to streamline your own communications. He will be glad to study your needs. Call him at your local Bell Telephone business office.

BELL TELEPHONE SYSTEM

PRIVATE LINE TELEPHONE • PRIVATE LINE TELETYPEWRITER
CHANNELS FOR: DATA TRANSMISSION • TELEMETERING
REMOTE CONTROL • TELEPHOTOGRAPH • CLOSED CIRCUIT TV

Davenport Named Executive

Dr Lee L. Davenport has been elected to an executive post with Sylvania Electric Products, Inc, and will become president of Sylvania-Corning Nuclear Corp upon its formation in the near future.

Dr Davenport was formerly with Perkin-Elmer Corp as executive vice president for six years. Before that he headed the Nuclear Laboratory of Harvard University where he played a major role in the design, construction, and operation of the university's post World War II synchro-cyclotron. Dr Davenport was a staff member of the Radiation Laboratory of Massachusetts Institute of Technology from 1940 to 1946.

The new company which Dr. Davenport will head is being formed as a jointly owned firm by Sylvania and Corning for expended research, development, and production activities in the atomic energy field.

DR LEE L. DAVENPORT

PERSONAL BRIEFS

William D. Dorway is new superintendent of operations for Public Utility District No. 1 of Snohomish County, Wash. He succeeds **James L. Marzluff** who will retire Mar. 1. In another change, **Merle E. Roberson** has the newly created job of superintendent of distribution.

Lawrence Heads EII

Electric Institute, Inc, recently elected as its president for 1957, Claude D. Lawrence, vice president of New England Service Co.

Other officers are Thomas H. Carens of Boston Edison Co, vice president; Ralph E. DeLoil, treasurer; Mandel M. Green of Northeastern Distributors, Inc, secretary; and James A. Galvin of Boston Edison, assistant secretary.

Robert K. Zimmerman is new assistant to Kansas City Power & Light Co's Vice President **Karl Koerper** . . . Georgia Power Co has named **Morris T. Reeves** manager of its newly created residential sales engineering division.

J. M. Dyer is new manager of engineering and **W. W. Ochsner** is new manager of electric system operation at Public Service Co of Oklahoma.

Harris E. Dexter retires this month as vice president in charge of commercial relations of Central Hudson Gas & Electric Corp. He will serve out his term as a member of the board of directors.

Florida Power & Light has named **Don E. Adams** director of agricultural development . . . **Sterling Matthews** transfers to Virginia Electric & Power Co's Blue Ridge District as district engineer.

Carl A. Hummel, executive vice president of Interstate Power Co, has been elected president of Iowa Utilities Association for 1957.

Niagara Mohawk Power Corp recently named **Ross A. Obenauer** system personnel representative . . . **Chester Belden** has assumed his new post as Montana Power Co's electrical engineer at Billings. Replacing him as assistant division superintendent at Havre is **David C. Johns,** and **Walter Kelley** becomes assistant division superintendent at Livingston.

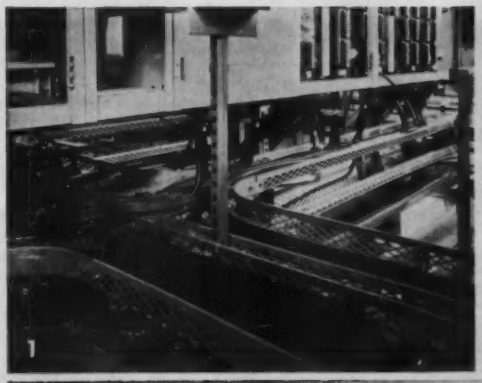
Appointment of **Paul A. Gray** to the newly created post of commercial services director has been announced by San Diego Gas & Electric Co. The company has also advanced **Truitt P. Richardson** to staff assistant in the department.

C. L. Doherty has been elected chairman of South Dakota's Public Utilities Commission and **Fred Lindekugel** vice chairman for the next two years . . . **Everett H. Krueger, Jr,** has been elected chairman of Ohio Public Utilities Commission for a six-year term.

New chief of Atomic Energy Commission's controlled thermonuclear branch in the Division of Research is **Dr Arthur E. Ruark,** Temerson Distinguished Service Professor of Physics at the University of Alabama.

Major responsibilities in Babcock & Wilcox Co's reorganized manufacturing department of the Boiler Division have been assigned to **O. R. Carpenter,** who continues as executive assistant and manager of quality control section; **G. J. Hartnett, Jr,** new manager of industrial engineering section; **G. A. Profita,** who becomes general superintendent of manufacturing; and **G. F. McDermott,** now Barberton Works superintendent.

J. Frank Frain has been named principal engineer by Kaiser Engineers Division of Henry J. Kaiser Co.



1 Smaller Diameters and light weight of RoMarine-RoPrene make it your best choice for trays, racks, and other metal race-way installations.

2 Easy To Pull, Rome Power distribution cable slips quickly into manholes and through conduit or duct runs.

3 Ideal For Underground applications, this Rome cable resists the corrosive effects of burial.

Underground, in ducts, and overhead . . .

Rome's power distribution cable helps you cut costs three ways

When you install RoMarine-RoPrene cable instead of a cable with metallic covering, you can save money three ways:

- **Lower original purchase or replacement cost**
- **Easier termination and splicing**
- **Reduced inventory levels**

Extremely versatile and tough, RoMarine-RoPrene cable can be buried directly in earth, installed in ducts or conduits, or hung overhead on poles. No longer must you stock three different kinds of 600-volt cable. And easier termination and splicing will provide further economies—every 30-minute saving is worth more than $2.00 to you!

Long service life also assured

Besides economy, you get real dependability from this versatile and rugged Rome cable. The tough Neoprene jacket assures an exceptionally long service life. It's light in weight; it's virtually immune to the effects of electrolysis, corrosion, and temperature extremes; and it's highly resistant to oils, acids, alkalies, moisture, abrasion, flame and weather.

All in all, this is an ideal 600-volt cable for electric utilities, industrial plants, rural electrification, and airport wiring. And it can often be used as a building wire that will save you money in the long run.

Approved and service proved

RoMarine-RoPrene is specifically approved by Underwriters' Laboratories as Type USE for underground service entrances. And it's approved by the CAA for airport wiring when CAA Specification L-824—with Type A insulation—applies.

Proved superior for general purpose wiring, this cable can be unhesitatingly recommended for 75°C. operation, except in the case of special circumstances specifically described in the National Electrical Code.

To get real economy *and* dependability, specify Rome's power distribution cable—RoMarine-RoPrene—for your next job. Contact your nearest Rome Cable representative for more information—or write to Department 602-B and ask for Bulletin RR-2. Rome Cable Corporation, Rome, New York.

ROME CABLE

CORPORATION

MEETINGS CALENDAR

FEBRUARY

National Adequate Wiring Conference—13th Annual Discussion, Sherman Hotel, Chicago, Ill., Feb. 21-22.

North Central Electrical League—20th Annual Upper Midwest Electrical Industry Convention, Leamington Hotel, Minneapolis, Minn., Feb. 24-27.

● **Wisconsin Utilities Association**—Engineering Institute on Power System Protection Meeting, University of Wisconsin, Madison, Wis., Feb. 25-27.

American Society of Heating and Air-Conditioning Engineers—63rd Annual Meeting, Chicago, Ill., Feb. 25-28; 13th International Heating and Air-Conditioning Exposition, Chicago, Ill., Feb. 25-Mar. 1.

Institute of Radio Engineers—Western Joint Computer Conference, Hotel Statler, Los Angeles, Calif., Feb. 26-28.

Electrical Equipment Representatives Association—Annual Meeting, St. Anthony Hotel, San Antonio, Tex., Feb. 27-Mar. 2.

Pacific Coast Electrical Association—Business Development Section, Sheraton-Palace Hotel, San Francisco, Calif., Feb. 28-Mar. 1.

Pennsylvania Electric Association—Relay Committee, Roosevelt Hotel, Pittsburgh, Pa., Feb. 28-Mar. 1.

MARCH

Southern Safety Conference—Conference and Exposition, John Marshall Hotel, Richmond, Va., Mar. 3-5.

National Rural Electric Cooperative Association—Annual Meeting, Conrad Hilton Hotel, Chicago, Ill., Mar. 4-7.

Louisiana State University—Annual Conference on High-Speed Computers, Baton Rouge, La., Mar. 5-8.

Street Tree and Utility Conference—Hotel Cleveland, Cleveland, Ohio, Mar. 7-8.

Engineers Joint Council—2nd Nuclear Engineering and Science Conference; 3rd International Atomic Exposition, and 5th Hot Laboratories and Equipment Conference, Convention Hall, Philadelphia, Pa., Mar. 11-15.

Electric Companies Public Information Program—Inter-Regional Committee, President Hotel, Kansas City, Mo., Mar. 7; Steering Committee, New York, Mar. 14.

National Electrical Manufacturers Association—General Engineering Committee, Switch and Enclosed Breaker Section, Chase Hotel, St. Louis, Mo., Mar. 13; Panelboard and Distribution Board Section, Molded Case Breaker Section and Busway Section, Chase Hotel, St. Louis, Mo., Mar.14.

Institute of Radio Engineers—Annual National Convention and Radio Engineering Show, Waldorf-Astoria Hotel and New York Coliseum, Mar. 18-21.

American Society of Mechanical Engineers—Gas Turbine Conference, Sheraton-Cadillac Hotel, Detroit, Mich., Mar. 18-21; Engineering Management Conference, William Penn Hotel, Pittsburgh, Pa., Mar. 27-28.

Edison Electric Institute—Industrial Relations Committee, EEI Headquarters, New York City, Mar. 21.

American Power Congress—19th Annual American Power Conference, Hotel Sherman, Chicago, Ill., Mar. 27-29.

Electric Meter Institute—Eighth Annual Session, University of Denver, Denver, Colo., Mar. 25-29.

Oklahoma Utilities Association—Annual Convention, Hotel Tulsa, Tulsa, Oklahoma, Mar. 28-29.

Illuminating Engineering Society—Pacific Northwest Regional Conference, Empress Hotel, Victoria, B. C., Canada, Mar. 28-30.

APRIL

Edison Electric Institute—Industrial Power and Heating Committee, Edgewater Beach Hotel, Chicago, Ill., April 1; Sales Conference, Edgewater Beach Hotel, Chicago, April 1-4; Accounting Division Advisory and Executive Committee, Madison Suite, Sheraton Park Hotel, Wash., D. C., April 8; National Accounting Conference of Electric & Gas Utility Accountants, held jointly with AGA, Washington, D. C., April 8-10; Industrial Relations Committee, jointly with Personal Sections of Indiana Electric Assn and Ohio Electric Utility Institute, and Personnel Practices Committee of Pennsylvania Electric Assn, Netherland Plaza Hotel, Cincinnati, Ohio, April 18-19; Meter and Service Committee, Sorono Hotel, St. Petersburg, Fla., April 24-26; Purchasing and Stores Committee Executive Committee and 10th Annual Meeting, Penn Sheraton Hotel, Pittsburgh, Pa., April 28-May 1; Accident Prevention Committee, Algiers Hotel, Miami Beach, Fla., April 29-May 1.

Southeastern Electric Exchange—24th Annual Conference, Boca-Raton Hotel and Club, Boca Raton, Fla., April 1-3.

National Industrial Conference Board—8th Atomic Energy Courses for Management, Westchester County Club, Rye, N. Y., April 1-6.

Indiana Electric Association—17th Annual Young Men's Utility Conference, Terre Haute House, Terre Haute, Ind., April 3-4.

● **American Institute of Electrical Engineers**—Great Lakes District Meeting, Hotel Fort Des Moines, Des Moines, Iowa, April 15-17.

Missouri Valley Electric Association—Engineering Conference, Hotel President & Municipal Auditorium, Kansas City, Mo., April 3-5.

Northwest Public Power Association—Annual Membership Meeting, Benjamin Franklin Hotel, Seattle, Wash., April 3-5; Engineering and Operations Section, Tacoma Utility Center and Winthrop Hotel, Tacoma, Wash., April 23-24.

● **Northeast Missouri Electric Power Cooperative**—Eighth Annual REA Electric Generating Plant Operation and Maintenance Conference, Phillips Hotel, Kansas City, Mo., April 8-11.

● **National Electrical Industries Show**—Fourth National Electrical Industries Show, 71st Regiment Armory, Park Ave and 34th St., New York City, April 8-11.

● **Institute of Radio Engineers**—First Annual Conference on Electronics in Industry, Illinois Institute of Technology, Chicago, Ill., April 9-10.

● **American Welding Society**—Fifth Welding Show, Convention Hall, Philadelphia, Pa., April 9-11.

● **Electrical Engineers (ASEE) Exhibition Ltd**—Sixth Electrical Engineers Exhibition, Earls Court, London, England, April 9-13.

● **Maryland Utilities Association**—Annual Spring Business Conference, Lord Baltimore Hotel, April 12.

● **Agricultural and Mechanical College of Texas**—Tenth Annual Conference for Protective Relay Engineers, A&M College of Texas, College Station, Tex., April 15-17.

● **Rocky Mountain Electrical League**—Spring Conference, Shirley-Savoy Hotel, Denver, Colo., April 21-24.

● **Association of Edison Illuminating Companies and Edison Electric Institute**—Meter and Service Committee, Soreno Hotel, St. Petersburg, Fla., April 24-26.

● Additions this week.

Rome station control cable helping Niagara Mohawk to meet load growth

Western New York was stretching its muscles, but it needed more electrical power in order to keep growing.

Niagara Mohawk met this need with a new addition to its power system, a 204,000-kw steam plant right on the edge of Lake Erie—all the power this booming area needed. One of the most modern in the world, the Dunkirk station is wired with Rome station control cables.

Why *Rome* cable?

Well, first of all, because of the proved dependability of Rome thermoplastic control cables, even under tough operating conditions. A sturdy Rome Synthinol jacket provides exceptional resistance to moisture, corrosion, abrasion, and flame.

Secondly, Rome's thermoplastic control cables can be installed faster. They're easier to handle, strip, and splice; and they have a high-gloss, low-friction surface which permits easy pulling through conduit and into control cabinets.

Finally, the use of Rome's tough control cables reduces cable maintenance problems to an absolute minimum. The individual conductors in the Dunkirk installation are insulated with RoLene (polyethylene), which is unaffected by water absorption, electro-osmosis, and low temperatures—conditions that often cause service interruptions.

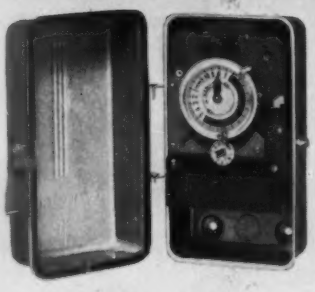
This Rome cable can be buried in earth, installed in ducts, trays, racks, strung aerially, or run in circuits combining all of these. And it is recommended for operating temperatures up to 75°C. All in all, Rome's station control cable is an excellent choice for demanding applications like this one.

Contact your nearest Rome Cable representative for more information—or write to Department 3, Rome Cable Corporation, Rome, New York.

ROME CABLE

CORPORATION

BUY RELIABLE STREET-LIGHTING CONTROL AT MINIMUM COST



The General Electric heavy-duty time switch is a low-cost method of reliable street-lighting control. Dependability and long service life mean you save on maintenance costs, too. These features of the TSA-40 time switch make it an outstanding buy:

- Exclusive contact shearing action breaks welds and keeps contacts clean.
- Completely weatherproof case gives protection in all climates.
- Extended temperature range allows operation in temperatures from −50 to 150°F.
- More wiring space and removable cover simplify installation and maintenance.
- Off-the-shelf delivery means you can get the TSA-40 *when you need it.*

Contact your local G-E time switch distributor or send for free bulletin today!

GENERAL ELECTRIC

SECTION B584-6
GENERAL ELECTRIC CO.
SCHENECTADY 5, N. Y.

Please send me free bulletin GEA-6468A on the TSA-40 time switch.

NAME.....

POSITION.....

STREET.....

CITY.....STATE.....

READERS FORUM

Old-Time Cables

To the Editor:

In the Jan. 14 issue you published an article by David Williams of Consolidated Edison of New York in which he indicates that the highest voltage cable in service in 1900 was 4,500.

There were two installations in the Twin Cities area at that time which exceeded that voltage by a considerable margin. In 1898 the St. Anthony Falls Water Power Co of Minneapolis, now a subsidiary of the Northern States Power Co, installed a system of 12,000-v cables which reached the various street railway substations throughout the Twin Cities, supplying alternating current for the railway rotary converters. Some of these cables were in service until recently when the street railway system was converted to buses.

In 1900 the St. Paul Gas Light Co, a predecessor of the Northern States Power Co, began operating two 25,000-v cables; one a rubber-insulated and the other a paper-insulated cable. Both of these operated at 25,000 v until 1924 and at 13,800 v until 1946 when they were retired. Each was three miles long and served to bring the output of a hydro plant into downtown St. Paul. The rubber-insulated cable apparently was manufactured by the Safety Insulated Wire & Cable Co, and the paper-insulated cable was made by the National Conduit & Cable Co. We believe that one or both of these companies were acquired by the General Cable Corp.

H. W. Meyer
Statistical Engineer
Northern States Power Co
Minneapolis 2, Minn.

Nashville Is Tops

To the Editor:

In an article, "Electric Space Heating, What Utilities Are Doing About It," which appeared in the Jan. 21 issue, you make the statement that "The City of Chattanooga has the largest single concentration of completely electric resistance heated homes in America."

You will be interested to know that the Nashville Electric Service, which was not mentioned, actually served 29,870 electrically heated homes and buildings as of Dec. 31, 1956.

If your figures were correct when you stated that there are 270,000 electrically heated homes and buildings in the U. S. at the end of 1956, it follows that the Nashville Electric Service has 11% of the total—certainly the greatest concentration in the country.

E. E. Parks
Manager
Lighting and Heating Dept
Nashville Electric Service
Nashville 3, Tenn.

• NES was not reported because it failed to return our questionnaire.

Supports PE Designation

To the Editor:

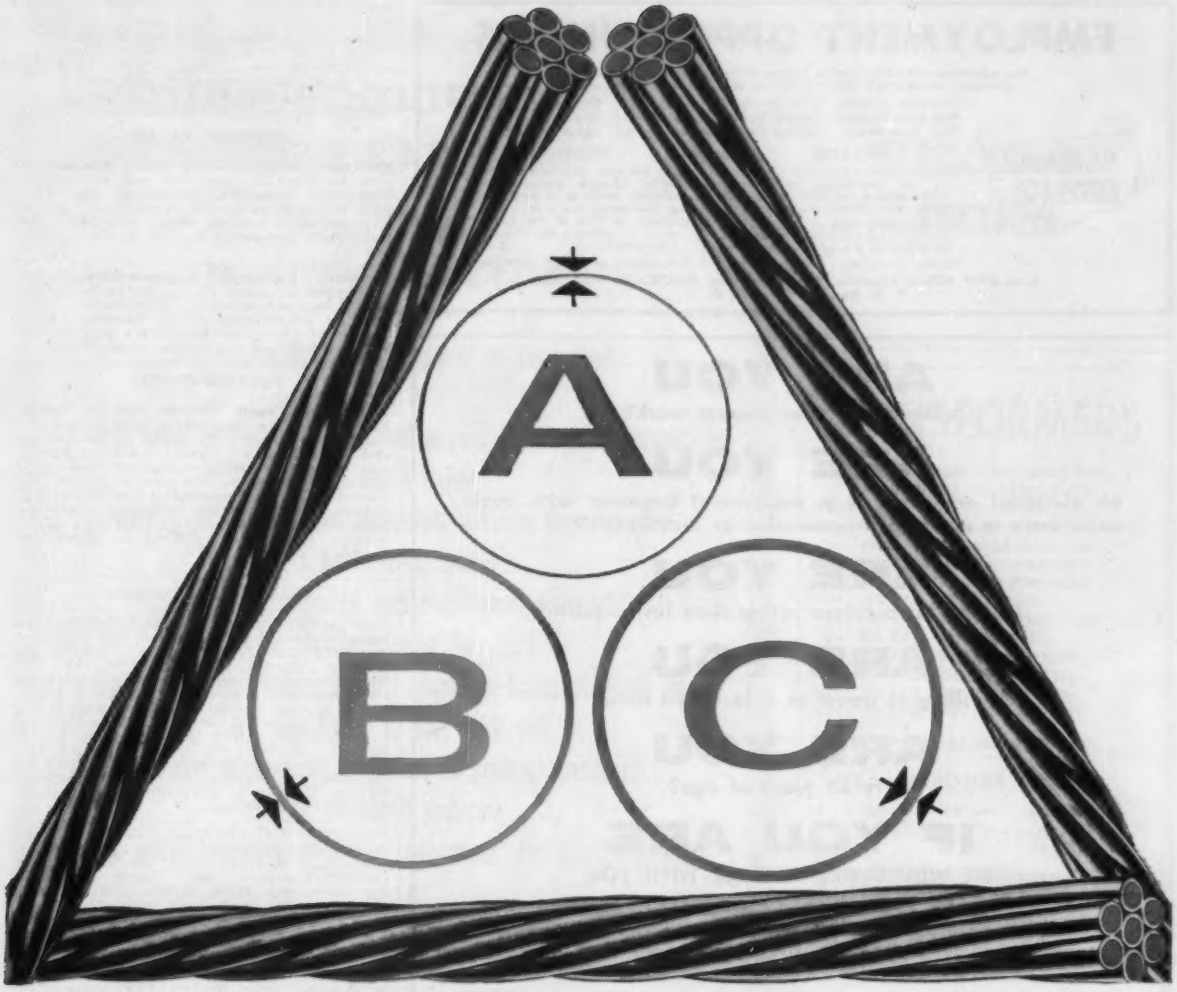
My attention has been called to the second editorial in your Nov. 12, 1956, issue. Your desire to have professional engineers identify themselves by the use of appropriate initials as a suffix to their names is commendable.

The National Society of Professional Engineers and its many state affiliates have long since promoted the same policy. We, too, believe that the profession can be better recognized by the lay public by regular use of such a designation. I would like to quote you Policy No. 13 of the National Society of Professional Engineers:

"It is the policy of the Society to promote the use of 'P.E.' as a suffix to the names of registered professional engineers."

I am sure that the society will be willing to cooperate with you in such an activity as you imply, and may I suggest that Paul Robbins, PE, who is our executive director, will be most happy to confer with you.

A. C. Kirkwood, P.E.
President
Missouri Society of
Professional Engineers
210 Monroe Street
PO Box 65
Jefferson City, Mo.



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Advertising in This Issue

Air Preheater Corp., The..... 45
Allen-Bradley Co. 19, 20
Allis-Chalmers Mfg. Co. ..2nd Cover
8, 9
American Telephone & Telegraph Co. 167
Anderson Electric Corp. 137

Baltimore & Ohio Railroad..... 18
Barkelew Electric Mfg. Co. 164
Bethlehem Steel Co. 173
Blackburn Corp., Jasper..... 129
Blaw-Knox Co., Power Piping & Sprinkler Div. 143
Brown Boveri Corp. 26
Buffalo Forge Company.....130, 131
Bussmann Mfg. Co. 108, 109

Chase-Shawmut Co 140
Chevrolet Div. General Motors.. 113
Circle Wire & Cable Corp. 125
Cole Electric Co. 178
Commercial Filters Corp. 116
Cope Inc., T. J. 132
Copperweld Steel Co. 111
Cornell-Dubilier Electric Corp. 114, 115

De Laval Steam Turbine Co. 33
Directory of Engineers..... 176
Dossert Mfg. Corp. 102
Dow Chemical Co. 156, 157
du Pont de Nemours & Co., (Inc.) Elastomer Chemicals Dept.... 121

Eastern Specialty Co. 164
Electric Service Works, Delta-Star Electric Division, H. K. Porter Company, Inc. 149
Electrical Engineers Equipment Co. 28
Electroline Company 10
Elliott Co. 29
Engineers, Directory of..... 176

Fanner Mfg. Co. 106
Federal Pacific Electric Co. 3rd Cover
122, 123
Ferranti Ltd. 51
Fisher-Pierce Co., Inc. 31
Four Wheel Drive Auto Co. 103

General Cable Corp. 46
General Electric Co.
Apparatus Dept. ...93, 94, 96, 97
127, 147, 172
Gould-National Batteries, Inc... 141

Hagan Chemicals & Controls, Inc.. .....100, 101
Harper Co., H. M. 154, 155
Hazard Insulated Wire Works.. 4
Hotpoint Co. 32
Hubbard & Co. 119

Indiana Steel & Wire Co., Inc... 177
Ingersoll-Rand 52
I-T-E Circuit Breaker Co. Switchgear Div. 38

KPF Electric Co. 49
Kearney Corp., James R. 37

Koppers Company, Inc.41, 42, 43, 44
Kuhlman Electric Co. ....4th Cover

Lapp Insulator Co., Inc. 54
Leeds & Northrup Co. 11
Line Material Co. 56, 57, 58
59, 60

Mallory & Co., Inc., P. R. 14
McCabe-Powers Auto Body Co. 39
Moloney Electric Co. 134, 135
Motorola Communications & Electronics Inc. 55

Ohio Brass Co. 25
Okonite Co., The 4
Onan & Sons, Inc., D. W. 152
Orangeburg Mfg. Co., Inc. 36

P L M Products, Inc. 136
Page Steel & Wire Div., American Chain & Cable..... 142
Palnut Company 124
Paranite Wire & Cable Div., Essex Wire Corp. 153
Pennsylvania Transformer Co. 16, 17
Philco Corp., Government & Industrial Div. 165
Pioneer Service & Engineering Co. 126
Pittsburgh Standard Conduit Co. 117
Porcelain Products, Inc. 30
Prat-Daniel Corp. 128
Premax Products Div., Chisholm-Ryder Co., Inc. 152

Radio Corp. of America..... 15
Reliable Electric Co. 133
Revere Copper & Brass, Inc. ... 99
Roebling's Sons Corp., John A... 27
Rome Cable Corp. 169, 171
Ryerson & Son Inc., Joseph T... 164

S&C Electric Co. 6, 7
Sangamo Electric Co. 158
Schwager-Wood Corp. 163
Searchlight Section 174, 175
Smith Co., S. Morgan 48
Southwire Company 50
Square D Co. 53
States Company 142
Subox, Inc. 110
Superior Switchboard & Devices Co. 136

Thomas & Sons Co., R. 47
Tobe Deutschmann Corp. 34, 35

United States Rubber Co. 138, 139
United States Steel Corp., American Steel & Wire Div.....104, 105

Wagner Electric Corp. 107
Westinghouse Electric Corp. 12, 13, 150, 151
Worthington Corp. 144, 145

■

PROFESSIONAL SERVICES 176

■

CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 174

EQUIPMENT
(Used or Surplus New)
For Sale 175

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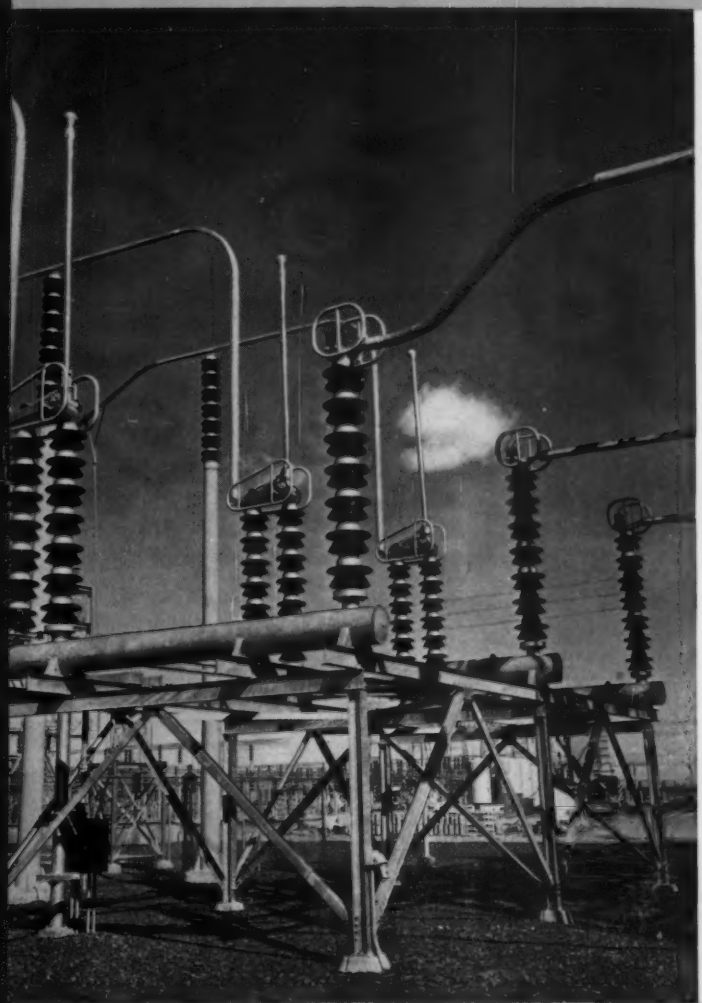

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578a

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